PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

Edited and Issued Monthly by

THE INSTITUTION OF ELECTRICAL ENGINEERS

In Association with

THE PHYSICAL SOCIETY

THE AMERICAN PHYSICAL SOCIETY

THE AMERICAN
INSTITUTE OF ELECTRICAL ENGINEERS

ABSTRACTS 2724-3039

VOLUME 49 NOVEMBER 1946 NUMBER 587

method similar to those of Southwell, and two proofs of the convergence are given. These are different from those previously given by Temple [Abstr. 1498 (1939)]. L. S. G.

518.5 : 517.944 = 4 *see Abstr.* 2730

519.2 2732

On the mean conserving property. RAO, C. R. *Proc. Indian Acad. Sci. A.*, **23**, 165–73 (*April*, 1946).—The general forms of the distribution laws which possess the mean conserving property are investigated mathematically and new frequency curves useful for graduation purposes and in tests of significance connected with means in random samples are derived. W. R. A.

519.2 2733

The large-sample theory of sequential tests. BARTLETT, M. S. *Proc. Camb. Phil. Soc.*, **42**, 239–44 (*Oct.*, 1946).

519.2 : 530.162 2734

The resultant of a large number of events of random phase. DOMB, C. *Proc. Camb. Phil. Soc.*, **42**, 246–9 (*Oct.*, 1946).—Rayleigh's method of deducing the probability distribution of the amplitude of the sum of n equal vibrations of random phase is generalized to the case when the amplitude of each vibration is a definite function of its phase. The same method is applied to the shot effect and it enables the distribution of random noise to be obtained. Campbell's Theorem and its generalizations can then be deduced from this.

519.21 : 532.5 : 533.7 = 4 2735

Random functions and their use in mechanics [interprétation mécanique]. BASS, J. *Rev. Sci., Paris*, **83**, 3–20 (*Jan.*, 1945) *In French.*—This important article begins with a discussion of the properties of random variables and random functions, and illustrations are taken from the irrotational motion of fluids following Jacobi's equation. Some of the topics discussed are random velocity fields, stochastic continuity and derivation of random functions. The mathematical treatment of various random processes is studied and application is made to the kinetic theory of gases. L. S. G.

519.251.8 2736

Linear "curves of best fit" and regression lines. LINDLEY, D. V. *Nature, Lond.*, **158**, 272–3 (*Aug.* 24, 1946).—Austen and Pelzer's solution [Abstr. 1771 (1946)] is not new. It is important to distinguish between the above lines; the former estimate the constant of proportionality between *true* values, the latter provide the best estimate of a true value from *observed* values.

ASTRONOMY . GEODESY 52

523.11 : 530.145 = 4 2737

The generalized cosmological problem and relativistic wave-mechanics. GIÃO, A. *Portugaliae Physica*, **2** (*No.* 1) 1–96 (1946) *In French.*—A new theory of the unification of general relativity and quantum mechanics leading, amongst other results, to Eddington's relation for the total number of elementary particles in the universe. The initial premise of the theory is that the metric of space-time must be completely and uniquely determinable by its defining equations, which are taken to be the formal analogues of Einstein's gravitational equations (with cosmical constant) for the first and second differential forms characterizing the space-time. By means of this notion of "complete determinability," the author shows that (*a*) space-time must have three "spatial" and one "temporal" dimensions, (*b*) it must be a subspace of a flat 5-dimensional manifold. Again, the "energy-tensors" occurring in the gravitational equations must be expressible in terms of two sets of wave-functions Ψ_{mn} (for the first differential form) and Φ_{mn} (for the second). In the first approximation the first differential form of space-time is

$$ds^2 = -d\tau^2 + P^2(\tau)\{d\theta^2 + \sin^2\theta(d\phi^2 + \sin^2\phi d\psi^2)\}$$

with $P(\tau) = P_0 \cosh(\tau/P_0)$, ($P_0$, a constant)

The second part of the paper deals with the physical interpretation in terms of gravitational, electromagnetic, etc., field-variables of the various vectors, tensors, etc., derived from Ψ_{mn} and Φ_{mn}. It follows that the paths of light-rays are null-geodesics of the second differential form and only in special cases of the first as well. Elementary particles may have different masses and charges. Finally the Eddington relation above referred to, as well as the ratio of the masses of the proton and electron, are obtained, protons and neutrons being regarded as "intimately united" electrons. In the third part of the paper there is solved the problem of the physical interpretation of Ψ_{mn} and Φ_{mn} which, since the theory does not permit of their being normalized, cannot be combined so as to give probability functions. But it is found that maxima of $\sum_m \Psi^2_{mn}$ correspond to the positions of elementary particles defined by their masses whilst maxima of $\sum_m \Phi^2_{mn}$ correspond to those of elementary particles defined by their charges. It is only fortuitously that these positions are identical. G. C. McV.

523.2 : 523.841.11 2738

Note on the origin of the solar system. HOYLE, F. *Mon. Not. R. Astr. Soc.*, **105** (*No.* 3) 175–8 (1945).—The planets are supposed to result from the supernova outburst of a binary companion to the primaeval sun. The basic assumptions of the theory are related to observations of the Crab nebula, which is probably the remains of the supernova of A.D. 1054. Asymmetry of ejection of material from the companion causes a recoil of 50 km/sec, sufficient to break up the binary if the separation of its components was originally comparable with the radius of Jupiter's orbit. The amount of material ejected is quite large enough to account for the planets; most of it in fact escapes owing to its high velocity (1 000 km/sec), and the remainder, ejected at low velocity, is retained by the sun since the heating effect of the parent star is removed before any thermal escape is possible. A. HU.

523.21 : 530.145 *see Abstr.* 2764

523.322 2739

The co-albedo of the moon. PETTIT, E. *Astrophys. J.*, **102**, 14–16 (*July*, 1945).—The ratio of the radiation emitted by the moon to the solar radiation received by it is defined as the co-albedo $1-A$, where A is the albedo determined radiometrically. The magnitude of the full moon in planetary heat outside the atmosphere at mean distance is computed from the albedo formula, the solar constant and the reflected radiation from the sub-solar point, and is used to calibrate the phase-radiation curve of an earlier paper [Abstr. 626 (1935)]. This re-calibration adds 0·4 mag. to the scale values of the curves, 0·26 mag. of which is accounted for by a rediscussion of the corrections applied. A. HU.

523.7 2740

On the sun's general magnetic field. COWLING, T. G. *Mon. Not. R. Astr. Soc.*, **105** (*No.* 3) 166–74 (1945).—If the sun's magnetic field decays solely as a result of electromagnetic effects, the time of decay is 10^{10} yr, i.e. of the order of the time-scale of the universe. The field may thus be a relic of a different primeval state of the universe. Thermal effects due to convection in a rotating sun can give a field of the right sign but less than the observed field by a factor of 10^7, and any dynamo-action growth of field requires 10^{18} yr to develop the present intensity. It is suggested that the field may grow by the convective extension of existing lines of force, or that permanent magnetization is present in the central regions of the sun. The effect of the solar rotation on its internal turbulence is considered. A. HU.

523.72 : 621.396.821 2741

Polarization of solar radio-frequency emissions. MARTYN, D. F. *Nature, Lond.*, **158**, 308 (*Aug.* 31, 1946).—The effect of the magnetic field of sunspots on the h.f. emission from the sun was demonstrated by the use of receiving aerials (200 Mc/s) adapted to receive only radiation circularly polarized in one sense. Seven times more right- than left-handed energy was received on July 26, 1946, when a large northern group of sunspots was approaching the solar meridian. Three days later, when the spot group had crossed the meridian, the results were reversed. Sudden short bursts [Abstr. 897 B (1946)] were confined to the stronger component.

523.72 : 621.396.821 2742

Circular polarization of solar radio noise. APPLETON, E. V., AND HEY, J. S. *Nature, Lond.*, **158**, 339 (*Sept.* 7, 1946).—Solar radio noise on 85 Mc/s was found to be left-handed (viewed looking forward along the direction of propagation) on July 27 and 28, 1946.

523.72 : 621.396.821 2743

Solar radiation on 175 Mc/s. RYLE, M., AND VONBERG, D. D. *Nature, Lond.*, **158**, 339–40 (*Sept.* 7, 1946).—Apparatus has been constructed for the automatic recording of 175 Mc/s noise down to 3×10^{-15} W, with which solar radiation can be detected under relatively quiet conditions. To distinguish the solar radiation from background galactic radiation a "Michelson interferometer" arrangement of two directive aerials separated by several wavelengths was used. The direction diagram of such a system has a number of sharp lobes, and its traversal across the sun showed signal oscillations superimposed on the steady background. When the two aerials were polarized at right angles to each other, the noise signals during periods of intense activity were found to be circularly polarized, indicating a non-thermal origin. On July 27–Aug. 3, 1946, the polarization was anti-clockwise (viewed along the positive direction of propagation). It was zero by Aug. 7, and on Aug. 8 40% clockwise.

523.72 : 621.396.821 2744

Origin of solar radiation in the 1–6 metre radio wavelength band. KIEPENHEUER, K. O. *Nature, Lond.*, **158**, 340 (*Sept.* 7, 1946).—Abnormally intense solar radio-frequency radiation is taken to be due to electrons revolving in the magnetic field of sunspots. The intensity relative to radiation from the photosphere (assumed to be a 6 000°K black body) is calculated, and gives a result of the same order as experimental observations (about 10^4). The radiation from the corona would be about $10^8\times$ that from the photosphere in the general field of the sun of 50 gauss; this field is therefore apparently shielded.

523.746 2745

The apparent distribution of preceding and following sunspots. GLEISSBERG, W. *Astrophys. J.*, **102**, 133–4 (*July*, 1945).—From counts of about 23 000 sunspots on the Mt. Wilson maps between 1917 and 1921 it is shown that preceding spots show a western excess, while following spots show an eastern excess; the overall eastern excess of spots as a whole resulting from the predominant effect of the latter. If the excesses are due to axial inclination of the spots the direction of slope must be opposite in the 2 cases, as would be expected on Bjerknes' theory. A. HU.

523.746 : 551.577.33 = 393 *see Abstr.* 3017

523.755 2746

Photographs of the corona taken during the total eclipse of the sun on July 9, 1945, at Pine River, Manitoba, Canada. HILTNER, W. A., AND CHANDRASEKHAR, S. *Astrophys. J.*, **102**, 135–6 (*July*, 1945).—Photometrically calibrated photographs were secured on a 6 in equatorial telescope and with a 4 in lens of 20 ft focus fed by a coelostat. Coronal streamers are more fully developed than expected at solar minimum, and it is noted that unusual auroral activity accompanied the eclipse. A. HU.

523.774 2747

The variations of absorption-line contours across the solar disc. TUBERG, M. *Astrophys. J.*, **103**, 145–64 (*March*, 1946).—A method for calculating theoretical absorption contours is proposed which does not assume a constant ratio between line and continuous absorption coefficient throughout the solar atmosphere. The appropriate boundary-value problem of line formation is solved in approximations higher than those hitherto considered. Theoretical contours are constructed on the third approximation for three points on the disc between centre and limb, and are compared with observed values for certain lines. The general trend of the observed variation is accounted for. A. HU.

523.821 : 523.851.3 = 3 *see Abstr.* 2753

523.841.11 : 523.2 *see Abstr.* 2738

523.841.3 2748

T Tauri variable stars. Joy, A. H. *Astrophys. J.*, **102,** 168–95 (*Sept.*, 1945).—A new class of variable stars is distinguished, the type star being T Tauri. The characteristics are: irregular light-variations of about 3 magnitudes; spectral type F5–G5 with emission lines resembling the solar chromospheric lines; low luminosity; and association with nebulosity. The spectra of the 11 variables so far classified are described. The radial-velocity measures indicate irregular atmospheric motions; the emission lines tend to be displaced towards the violet with respect to the absorption lines. A. HU.

523.841.372 2749

The velocity curves of seven Cepheid variables. Struve, O. *Astrophys. J.*, **102,** 232–8 (*Sept.*, 1945).—Radial velocities for the following Cepheids in Cygnus are determined from 113 McDonald spectrograms: V386, MW, VY, BZ, TX, SZ and CD. The velocity curve for BZ Cyg in 1944 differs markedly from the curve obtained in 1934–36. A. HU.

523.841.9 2750

Intermediary elements for eclipsing binaries. Russell, H. N. *Astrophys. J.*, **102,** 1–13 (*July*, 1945).—Recommendations are made for the investigation of eclipsing binaries by first determining intermediary elements and then, if the observations warrant, correcting these to allow for refinements. The simplest generally useful model consists of 2 similar prolate ellipsoids. Limb darkening, gravity effect and reflection effect must all be included in the initial discussion: when the radii, masses and spectral types of the components are known, all these can be calculated theoretically and the elements adjusted within the physical restrictions. A definitive discussion by the method of "false position" is justified only in a few well-observed binaries: where only photometric observations are available, limiting elements should be quoted. The method is analogous to the determination of cometary orbits. A. HU.

523.841.9 2751

Spectrographic observations of thirteen eclipsing variables. Struve, O. *Astrophys. J.*, **102,** 74–127 (*July*, 1945).—Astrophysical questions encountered in recent studies of spectroscopic and eclipsing binaries are reviewed categorically, particular attention being paid to axial rotation, variable line intensity, reflection effect, emission-line formation, deformation of velocity curves, and extended shells. The spectroscopic features and radial velocities of the following eclipsing binaries are then studied on more than 500 spectrograms: RW Per, EY Ori, SV Gem, RU Mon, AO Mon, SW CMa, UZ Pup, VZ Hya, Ru Cnc, Y Leo, RW UMa, SS Boo, AW Peg. A. HU.

523.841.9.035.92 2752

The photometric orbit of QY Aquilae. Whitney, B. S.; Russell, H. N. *Astrophys. J.*, **102,** 202–7 (*Sept.*, 1945).—Photographic and visual observations of this star with a 10 in reflector are used to deduce light curves, which show asymmetries of unknown origin. The colour index at maximum indicates a spectral type of *g*G2 or *d*G6, that at minimum *g*G9 or *d*K1. Comparison of the photographic radius with the visual value indicates that both components are surrounded by red atmospheres of great depth. A. HU.

523.851.3 : 523.821 = 3 2753

Photometry of the star cluster N.G.C.752 in Andromeda. Graff, K. *S.B. Akad. Wiss. Wien*, **149,** 2*a* (*Nos.* 5–6) 291–302 (1940) *In German.*—Discusses previous results by Jungkvist and Heinemann with some recent additional material. The magnitudes are compared and re-reduced to the Harvard photometric system. 220 stars down to magnitude 13 are listed, the Heinemann number being retained. E. G. M.

523.854.12 = 3 2754

Selective absorption in the boundary region Scutum–Sagittarius. Graff, K. *S.B. Akad. Wiss. Wien*, **149,** 2*a* (*Nos.* 3–4) 213–30 (1940) *In German.*—Visual colorimetry with the 68 cm refractor at Vienna is applied to the region 17 h 53 m to 18 h 23 m in R.A. and −10° to −23° in dec. The colours of all B.D. stars of type B0–B8 in the 85 degs² concerned are estimated on a scale defined by a series of comparison stars between B9 and M, and the reddening is deduced in tenths of a spectral class. A chart of the region shows that the greatest reddening occurs not near the visible dark clouds but in the richer star-fields. A. HU.

523.991 2755

Occultations observed at the Radcliffe Observatory, Pretoria, in the years 1939 to 1944. *Mon. Not. R. Astr. Soc.*, **105** (*No.* 3) 179–88 (1945).

523.991 2756

Occultations of stars and planet by the moon, observed at the Nizamiah Observatory, Hyderabad, during the year 1944. *Mon. Not. R. Astr. Soc.*, **105** (*No.* 3) 189–90 (1945).

525.14 : 526.6 = 393 2757

New formulae for the deviations of the vertical and Laplace's theorem. Vening Meinesz, F. A. *Versl. Ned. Akad. Wet. Afd. Natuurk.*, **53** (No. 4) 160–8 (1944) *In Dutch.*—Laplace's theorem concerning deviations between astronomical (suffix *a*) and geodetic (suffix *g*) longitude and azimuth determinations, $\alpha_a - \alpha_g = -(\lambda_a - \lambda_g)\sin\phi$ is correct to within terms of the second order in the vertical deviation. Helmert's formula for systems of deviations of the vertical, adding first-order terms of the components ξ_0 and η_0 of the vertical deviation at the central point P_0 is criticized and a formula is given for the changes ξ_1 and η_1 of the vertical deviation in P_1 caused by ξ_0 and η_0. J. A. W.

526.6 : 525.14 = 393 *see Abstr.* 2757

PHYSICS 53

FUNDAMENTALS 530.1

530.1 = 82 2758

Contemporary physics and energetics. Fabrikant, V. A. *Elektrichestvo* (*No.* 5) 3–8 (1946) *In Russian.*—A general survey of contemporary physics is given. The basis of modern physical science rests on de Broglie's formula: $\lambda = h/mV$ and Einstein's law: $E = mc^2$. Principles of wave mechanics are ex-

plained with the help of conceptions of potential barrier and "tunnel effect." A physical picture of electric currents in conductors is presented: electrons move freely in insulators and conductors alike, but react only in the latter when an electromagnetic field is applied. The indeterminacy principle is discussed and applied in the concrete example of utilization of the outer electron surface of carbon atoms (chemical energy); the result agrees with the known thermal yield of burning coal. The present state of nuclear physics and atomic disintegration is surveyed. A. L.

530.12 : 531.26 *see Abstr.* 2778

530.12 : 531.51 2759

Imaginary waves in canalised space; followed by: The atom and the spiral nebula in a Riemannian space with coefficients depending on the time. CARNET, P. *Ann. Fac. Sci. Toulouse*, **7**, 1–70 (1945).—The first part of the paper contains the theory of "canalized" spaces. By this is meant that, by a suitable partitioning of space, certain integrals over surface elements can be propagated by variable surfaces and even by discontinuous fragments of surface, each one propagating itself along its own compartment. Mathematically, the basis is a generalization of Stokes's theorem, which is given. Application is made to the differential equation of planetary orbits deduced from Schwarzschild's solution of Einstein's gravitational equations, particularly to the degenerate spiral orbits. Also to the propagation of light-waves in classical mechanics, but with the assumption that the velocity of light is $c/(1 - C/r)$ where c, C are constants and r a polar co-ordinate. This is formally the velocity of light in the Schwarzschild field. The second part of the paper deals with space-times whose metric is of the form

$$ds^2 = e^{\nu}dt^2 - e^{\mu}dr^2 - r^2d\theta^2 - r^2\sin^2\theta d\phi^2$$

where ν, μ are functions of r, t. A roundabout method of analysis due to Delsarte ("binary ds^2") is used to calculate the Einstein gravitational equations with the cosmical constant equal to zero. A solution is then found corresponding to a mass-particle at $r = 0$ and an "expanding" distribution of matter-energy outside it of zero density and constant pressure. The paths of light-rays and of planetary particles in this field are worked out in detail. In particular the degenerate orbits are said to reproduce the arms of spiral nebulae if it is assumed that there are two mass-particles at $r = 0$, the fields of which are superposable, one of which has a positive and the other a negative mass. The degenerate orbits are, in certain other cases, regarded as corresponding to the electron system in an atom. G. C. McV.

530.145 = 5 2760

On the dimensions of elementary particles. SCANDONE, F. *Nuovo Cim.*, **3**, 57–60 (*Feb.*, 1946) *In Italian.*

530.145 2761

On the vanishing of div $E - 4\pi\rho$ in quantum electrodynamics. BELINFANTE, F. J. *Physica, 's Grav.*, **12**, 17–32 (*April*, 1946).—The difference $(\dot{\eta}/c)$, where $\eta = \text{div } A + (\dot{\phi}/c)$ cannot have a zero eigenvalue in quantum mechanics, owing to the commutation rules, although η is usually ignored in this sense. Ignoring variables in the Hamiltonian really means limiting to the sub-space $\eta = 0$ the domain of integration of the wave-function on which η acts. Some corresponding limitations on the form of the Hamiltonian are discussed and it is shown that they are satisfied in electro-dynamics if both $\eta = 0$ and effectively $\dot{\eta} = 0$ are imposed. Relativistic invariance of the scheme is proved. G. J. K.

530.145 2762

On the motion of a Gaussian wave-packet in a parabolic potential field. COULSON, C. A., AND RUSHBROOKE, G. S. *Proc. Camb. Phil. Soc.*, **42**, 286–91 (*Oct.*, 1946).—The quantum-mechanical behaviour of the packet is contrasted with that which follows from pure classical mechanics. The similar problem for a free particle is also discussed.

530.145 2763

Elimination of certain divergencies in quantum electrodynamics. GUSTAFSON, T. *Nature, Lond.* **158**, 273 (*Aug.* 24, 1946).

530.145 : 523.11 = 4 *see Abstr.* 2737

530.145 : 523.21 2764

Quantization of the solar system and its consequences. BARNÓTHY, J. *Nature, Lond.*, **158**, 309 (*Aug.* 31, 1946).—[See Abstr. 2254 (1946)]. If the spin quantum number of a planet is to remain constant during its cooling, the kinetic energy of revolution must increase at the expense of orbital energy. If centrifugal force exceeds gravitational, the planet will be unstable, and this condition limits the quantum numbers available for the existing planets. It is suggested that the planetoid ring between Jupiter and Mars was originally a planet with a quantum number unable to maintain stability. The hypothesis is further extended to the galactic system.

530.145 : 531.19 : 536.48 = 5 2765

Generalized quantum statistics and the properties of liquid helium. GENTILE, G., JR. *Nuovo Cim.*, **19**, 109–25 (*April*, 1942) *In Italian.*—The author considers quantum statistics in which the maximum number, d, of particles which can occupy a given phase cell is no longer 1 (Fermi–Dirac statistics) or ∞ (Bose–Einstein statistics), but may be any positive integer. He then considers thermodynamically Einstein's theory of gas degeneration by postulating that d is equal to the total number of particles in the gas. The results of the investigation are applied to explain various properties of liquid He II, viz. superfluidity, viscosity, thermal conductivity. V. C. A. F.

530.145 : 537.122 2766

The classical equations of motion on an electron. ELIEZER, C. J. *Proc. Camb. Phil. Soc.*, **42**, 278–85 (*Oct.*, 1946).—A set of relativistic classical equations of a radiating electron in an electromagnetic field are derived from the principle of conservation of energy, momentum and angular momentum. It is shown that these equations lead to results more in harmony with the usual scheme of mechanics than do the Lorentz–Dirac equations. When applied to the motion of the electron of the hydrogen atom, these equations permit the electron falling into the nucleus, which the Lorentz–Dirac equations do not. When applied to the motion of an electron disturbed by a pulse of radiation, the solution is in a more symmetrical form. The expression for the scattering cross-section for light

of frequency ν is the same as the classical Thomson formula for small ν, and varies as ν^{-4} for large ν.

530.145.6 = 4 2767

The expression $\lambda = h/mv$ for the de Broglie wavelength associated with moving particles. DE BEIRES, R. S. *Portugaliae Physica*, **2** (*No.* 1) 121–3 (1946) *In French.*—A derivation of this expression assuming that $E = h\nu$, and that particles and waves are so related that the ratio of the action and time integrals of Maupertuis and Fermat along the path is a function of ν. G. J. K.

530.145.6 : 539.18 = 5 2768

The meson field equations in five dimensional space. CALDIROLA, P. *Nuovo Cim.*, **19**, 25–35 (*Feb.*, 1942) *In Italian.*—The theory of the meson field is developed in a pseudo-Euclidean space with the metric $ds^2 = dx^2 + dy^2 + dz^2 - c^2dt^2 + dw^2$, and it is shown that there exists a 5-vector from which the field equations may be derived. The pure meson field is first discussed, and then charge and current, and so nucleons, are introduced. Explicit expressions for the field equations are given in each case. The physical significance of the 5th dimension is also discussed and it is shown that

$$w = m_0 c \int_{t_0}^{t} dt/m$$

where $m = E/c^2$, m_0 being the rest mass and E the energy. Some properties of generalized vectors are recorded briefly. L. S. G.

530.145.63 = 4 2769

Matrix theory of the representations of particles of spin $h/2\pi$. PETIAU, G. *Rev. Sci., Paris*, **83**, 67–74 (*Feb.*, 1946) *In French.*—Details of relations and irreducible representations of matrices formed from 2, 3, 4 or 5 matrices A_μ satisfying the commutation rules $A_\mu A_\nu A_\rho + A_\rho A_\nu A_\mu = A_\mu \delta_{\rho\nu} + A_\rho \delta_{\mu\nu}$. Kemmer has already discussed the general properties and the case of 4 matrices [Abstr. 80 (1944)]. The reduction is made of such matrices as occur in the photon theory of de Broglie. G. J. K.

530.162 2770

Properties of the fortuitous force in the Einstein–Langevin equation. MILATZ, J. M. W., AND ORNSTEIN, L. S. *Physica, 's Grav.*, **7**, 793–801 (*Oct.*, 1940).—In a model case it was possible to indicate the relation between F, the force in the Einstein–Langevin equation, and the force that acts in reality. In this way the mean square of F and the function $\overline{F(t)F(t+\delta)}$ could be calculated, thereby enabling one to discuss their properties. It appeared that in the usual treatment $\overline{F^2}$ tends to infinity because the time of correlation, which depends on the time of interaction during a collision, is accepted to be zero.

530.162 : 519.2 *see Abstr.* 2734

MECHANICS OF SOLIDS 531

531.19 : 511.2 2771

Statistical mechanics and the partitions of numbers. AULUCK, F. C., AND KOTHARI, D. S. *Proc. Camb. Phil. Soc.*, **42**, 272–7 (*Oct.*, 1946).—The statistical mechanics of an assembly of identical harmonic oscillators is used to deduce the Hardy–Ramanujan asymptotic expressions for the number of partitions of an integer into either smaller positive integers or into different positive integers. Asymptotic formulae at high and low temperatures of the thermodynamic functions E, S and F are given for Bose, Fermi–Dirac and classical statistics. G. J. K.

531.19 : 532.7 : 533.7 2772

Errata: Statistical mechanics of transport processes. I. General theory. KIRKWOOD, J. G. *J. Chem. Phys.*, **14**, 347 (*May*, 1946).—[Abstr. 2043 (1946)].

531.19 : 536.48 : 530.145 = 5 *see Abstr.* 2765

531.19 : 536.7 : 548.73 2773

A theorem in statistical mechanics. EHRENBERG, W. *Nature, Lond.*, **158**, 308 (*Aug.* 31, 1946).—The probability P of finding a system at temperature T with energy E is $P \propto \Omega \exp - E/kT$ where Ω is the multiplicity of the level E. For the system under test, P is a maximum with respect to any parameter n, so that

$$\frac{\partial \log P}{\partial n} = 0 = \frac{\partial \log \Omega}{\partial n} - \frac{1}{kT}\frac{\partial E}{\partial n}$$

An application of the theorem to a monatomic crystal with n Schottky defects is given.

531.24 : 621.317.39 2774

An electrical airplane C.G. position indicator. NILAKANTAN, P. *Proc. Indian Acad. Sci. A*, **23**, 174–8 (*April*, 1946).—An electrical circuit is described which enables the centre of gravity position of an airplane to be determined after only a few adjustments requiring very little skill. The general principles are applied to work out the c.g. position in an airplane of 6 000 lb gross weight. W. R. A.

531.252.2 : 536.413 = 397 2775

Thermal stresses in rings, tubes and discs. NORDSTRÖM, L. *Tekn. Tidskr.*, **76**, 475–83 (*May* 11, 1946) *In Swedish.*—A number of diagrams are given, based on the theory of elasticity, from which deformations and stresses arising from non-uniform heating may be found when boundary temperatures, diiatation coefficients and the modulus of elasticity of the material are given. Numerical examples are given. J. A. W.

531.259 2776

Elastic stresses along the bottom of a dam. GLAGOLEV, N. I. *C.R. Acad. Sci., URSS*, **34** (*No.* 7) 187–91 (1942).—The bottom is supposed to be elastic and the dam perfectly rigid. Formulae due to Muskhelishvili are used to calculate the stresses in two cases depending on the nature of the contact between the dam's foot and the bottom, (1) limit equilibrium along the contact, (2) full slip along the contact. L. S. G.

531.259 : 621.38.032.53 2777

Stresses in cylindrical glass-metal seals with glass inside. HULL, A. W. *J. Appl. Phys.*, **17**, 685–7 (*Aug.*, 1946).—It was shown previously [Abstr. 367 (1936)] that, when a cylinder of glass is sealed to the outside of a metal rod, the principal stresses in the glass are of opposite sign, so that tensile stresses cannot be avoided except by a perfect match. In this article the stresses are calculated for a solid glass cylinder sealed to the inside of a metal cylinder. It is shown that the stresses are all of the same sign, so that a moderate mismatch in thermal expansion, with

the metal expansion the greater, is allowable and perhaps desirable. Large differences in expansion should be avoided, because of the shearing stresses at the ends.

531.26 : 530.12 2778

Schwarzschild interior solution in an isotropic co-ordinate system. WYMAN, M. *Phys. Rev.*, **70**, 74–6 (*July* 1 *and* 15, 1946).—The relativistic equations for the case of a sphere of perfect fluid of constant density are solved when an isotropic co-ordinate system is used. It is again found that a sphere of given density has upper bounds on its mass and radius but that these upper bounds are smaller than those given by the ordinary Schwarzschild solution.

531.51 : 530.12 *see Abstr.* 2759

531.558 = 3 2779

An interpolatory procedure for calculating the trajectory of a projectile, and its alteration by varying the angle of projection. PIMIÄ, L. *Comment. Phys. Math. Helsingf.*, **12** (*No.* 7) 13 *pp.* (1944) *In German.*—The equations of motion of the projectile are solved by means of a power series and the solution is used to develop an interpolation method for computing paths, based on 3 basic paths. Some numerical examples are considered. L. S. G.

531.562/.565 = 3 2780

The perturbation theory of external ballistics. LIIKKANEN, I. *Comment. Phys. Math., Helsingf.*, **12** (*No.* 1) 72 *pp.* (1944) *In German.*—A comprehensive mathematical treatment of the motion of a projectile. The differential equations of motion are set up for the normal motion and integrated numerically. Perturbations of the motion are then considered; these depend on: (1) The initial velocity and angle of projection; (2) the variation of the pressure, temperature and state of motion of the air from the normal state; (3) variation of the acceleration due to gravity with height and latitude. Differential equations are set up for the perturbed motion and solved by a numerical method due to Nevanlinna. Some numerical examples are considered. L. S. G.

531.565 = 3 2781

Deviations of projectiles caused by the earth's rotation, taking air resistance into account. SIMONS, L. *Comment. Phys. Math., Helsingf.*, **12** (*No.* 11) 12 *pp.* (1944) *In German.*—The differential equations governing the deviations are written down and transformed into a form suitable for numerical integration. Some examples are discussed in detail. L. S. G.

MECHANICAL MEASUREMENTS 531.7

531.715.27 2782

A photo-electric method of indicating small displacements and of timing a moving body. PERFECT, D. S., AND WITHERS, R. M. J. *J. Sci. Instrum.*, **23**, 204–8 (*Sept.*, 1946).—The sharp edge of a small stainless steel prism attached to the moving body is caused to pass across the narrow image of a fixed slit. The two reflected components into which the prism divides the incident beam of light fall respectively on two photocells which form part of a balanced circuit fed with an input of frequency 10 kc/s. For a specific position of the prism relative to the image the amplified output has a sharp minimum. A positional sensitivity of 0·05 μ is attained; the system is stable within this range for at least 3 min. It is stable within a range of 0·15 μ over a period of a few hours. The system was primarily designed for determining, with an accuracy of 1 msec, the times when a slowly moving carriage reaches certain positions.

531.787.4 2783

A method for the accurate determination of pressures from 100 to 1 mm [Hg]. KISTEMAKER, J. *Physica, 's Grav.*, **12**, 217–26 (*July*, 1946).—The method is based on X-ray shadowgraphs of the manometer. An accuracy of about 3 micron Hg is obtained. The influence of distortions of the gelatine layer on the photographic plate is investigated, and the influence of Hg vapour in the apparatus is discussed. [See Abstr. 1245 (1946)].

MECHANICS OF LIQUIDS 532

532.122 : 532.7 *see Abstr.* 2792

532.13 : 532.72/.74 = 3 *see Abstr.* 2801

532.13 : 534.845.2 *see Abstr.* 2814

532.13 : 539.133 2784

On the application of viscosity data to the determination of the shape of protein molecules in solution. BURGERS, J. M. *Proc. K. Ned. Akad. Wet.*, **43** (*No.* 4) 425–35; (*No.* 5) 645–52 (1940).—In continuation of previous work [see Abstr. 1696 (1940)], formulae for the specific increase of the viscosity of suspensions of elongated particles are supplemented by expressions for cases where the particles (1) have the form of oblate ellipsoids of revolution, or (2) can be represented by a few rigidly connected spheres. In particular, systems comprising 4 spheres arranged at the corners of a square, 8 spheres at the corners of a cube, or 2 rigidly connected spheres, are discussed. It is assumed throughout that all positions of the particles are equally probable. An elongated rotational ellipsoidal shape of protein molecules does not fit experimental sedimentation data sufficiently well; discrepancies remain if it is assumed that molecules of this shape are hydrated or have the form of oblate ellipsoids of revolution. Model systems consisting of 2 spheres, or 8 spheres at the corners of a cube, fit the experimental data equally well; a prismatic system is also satisfactory. J. S. G. T.

532.133 : 535.551 : 541.64 2785

The behaviour of macromolecules in inhomogeneous flow. KRAMERS, H. A. *J. Chem. Phys.*, **14**, 415–24 (*July*, 1946).—The statistical behaviour of the individual links of dissolved polymer molecules is investigated, and results equivalent to Hermans' [Abstr. 2500 (1946)], based on the relative diffusion of the molecule ends, are obtained. The method can, however, be also applied to molecules with branching points and rings.

532.133 : 537.226.31 *see Abstr.* 2884

532.137 2786

Errors in viscometry due to surface tension. BARR, G. *Proc. Phys. Soc. Lond.*, **58**, 575–85 (*Sept.*, 1946).—In viscometers of the Ostwald type used for the determination of kinematic viscosities relative to water, surface tension causes a reduction of the head available and increases the time of flow. The correc-

tion is not proportional to the surface tension and earlier estimates of the correction are shown to be suspect. Two methods are proposed for eliminating the correction during the calibration of viscometers.

532.5 : 533.7 : 519.21 = 4 *see Abstr.* 2735

532.511 = 4 2787

General equations of the hydrodynamics of perfect fluids. DE BEAUREGARD, O. C. *C.R. Acad. Sci., Paris*, **222**, 369–71 (*Feb.* 11, 1946) *In French.*—The author defines an incompressible perfect fluid as one in which the four-dimensional velocity V^i and force-density f^i satisfy the equations $f^i = \partial^i w$, $V^i f^i = 0$ (w being the pressure). He then shows that V^i is expressible in terms of two potentials, one scalar and one vector. He also calculates the four-dimensional force-vector due to V^i. G. C. McV.

532.522 : 533.17 = 5 *see Abstr.* 2806

532.525 + 532.542 2788

The flow of boiling water through nozzles, orifices and pipes. BURNELL, J. G. *J. Instn Engrs, Aust.*, **18**, 41–9 (*March*, 1946).—Reviews the published mathematical and experimental work and presents fresh data. For the discharge through nozzles, a formula is derived having a logical physical basis and agreeing closely with all the experimental data. For the flow in pipes, experimental data are presented giving discharges greater than those calculated from simple thermodynamic theory, the explanation being that the water and steam in the flashing mixture flow at different velocities.

532.542 + 532.525 *see Abstr.* 2788

532.612.4 2789

On the surface tension of mercury. KEMBALL, C. *Trans. Faraday Soc.*, **42**, 526–37 (*June–July*, 1946).—An apparatus is described for the measurement of the surface tension of Hg by the sessile drop method *in vacuo* or in the presence of vapours, to an accuracy of ¼%. A new type of mercury cut-off, capable of taking differences in pressure of over an atmosphere is also described. The prismatic shape of the window through which the drop was viewed is shown to be an important source of error. Details of the magnitude of this error and the means of correcting for it are given. A value of 484·0 dynes/cm at 25°c was found for the surface tension *in vacuo*, which is in agreement with other recent values. Contamination by high grade vacuum grease was demonstrated and the adsorption is compared with the effect of lower hydrocarbons.

532.612.4 : 532.64 2790

Jones–Ray effect, wettability, and zeta-potential. CASSEL, H. M. *J. Chem. Phys.*, **14**, 462 (*July*, 1946).—An alternative to Langmuir's explanation of the Jones–Ray effect [see Abstr. 2276 (1946)] is offered—that minute concentrations of strong electrolytes may increase the wetting angle.

532.612.4 : 532.72 : 541.183.33 2791

Time-dependence of boundary tensions of solutions. I. The role of diffusion in time-effects. WARD, A. F. H., AND TORDAI, L. *J. Chem. Phys.*, **14**, 453–61 (*July*, 1946).—A rigorous mathematical analysis is attempted. The limitations of previous diffusion theories are discussed and a general theory is derived, which allows for back-diffusion and makes no special physical assumptions. It is possible to use Fick's equation to calculate the total amount of solute which diffuses from a semi-infinite bulk solution into the surface if the concentration immediately under the surface is known at various times throughout the process; this may be deduced from the variation of surface tension with time and the final equilibrium values. The methods of this theory are applied to analyse recent data on time-effects of short duration. It is concluded that even in cases where the variation of the surface tension is over in less than a second the rate-determining process is not diffusion. Even for these very rapid changes one is therefore led to assume the existence of an activation barrier which determines the rate of adsorption.

532.64 : 532.612.4 *see Abstr.* 2790

532.694.1 : 545.844 *see Abstr.* 2995

532.7 : 532.122 2792

On the theory of liquids. BRINKMAN, H. C. *Physica, 's Grav.*, **7**, 747–52 (*Oct.*, 1940).—Using Eyrings concept of free volume [see Abstr. 5394 (1937)] a difference-equation for the free energy of liquids is derived. This equation yields a formula for the compressibility of liquids which contains only one constant, viz. the volume of the molecules in the closely packed state b. A satisfactory agreement between theory and experiment is obtained, while b has nearly the same value as deduced from Van Wijk's and Seeder's theory of viscosity [Abstr. 1021 (1939)].

532.7 : 533.7 : 531.19 *see Abstr.* 2772

532.7 : 536.423.1 = 4 2793

On the attraction constant of liquid molecules at the boiling point under fixed pressure. DUCH, G. *C.R. Acad. Sci., Paris*, **222**, 786–7 (*April* 1, 1946) *In French.*

532.7 : 541.135 *see Abstr.* 2963

532.72 = 3 2794

The diffusion of lithium, sodium and thallium carbonates in aqueous solution. ÖHOLM, L. W. *Comment. Phys. Math., Helsingf.*, **12** (*No.* 2) 5 *pp.* (1944) *In German.*—Experimental values for the diffusion coefficients for Li_2CO_3, Na_2CO_3 and $TlCO_3$ are reported, and compared with the theoretical values, calculated by means of Nernst's formula. L. S. G.

532.72 = 4 2795

Phenomenological theory of the Soret effect. DE GROOT, S. R. *Physica, 's Grav.*, **9**, 699–708 (*July*, 1942) *In French.*—The boundary problem that arises from phenomenological assumptions about the diffusion and thermal diffusion process between parallel plates in liquids (Soret effect) is rigorously integrated. From the solution an approximate expression is derived, that can be applied for the usual temperature differences and ratios of thermal diffusion coefficient to diffusion coefficient (Soret coefficient). The theory cannot easily be extended to the Clusius and Dickel separation process, in which there is an additional convection flow.

532.72 = 4 2796

Phenomenological theory of the thermo-gravitational process of separation in a liquid. DE GROOT, S. R. *Physica, 's Grav.*, **9**, 801–16 (*Sept.*, 1942) *In French.*—The equations for the diffusion and convection processes in liquids are put forward. In a discussion

f previous attempts to develop a theory of separation y thermal diffusion, it is pointed out that the method roposed by Furry, Jones and Onsager for calculation f separation in gases [Abstr. 2666 (1939)] can be dapted to the separation process in a liquid. A eneral expression for the separation, depending on wo dimensionless functions of the parameters of the roblem, is obtained and the influence of some of hese parameters is considered (time available for the eparation, distance between hot and cold plate, eight and inclination of the apparatus, temperature radient). Some numerical calculations are repre- ented in diagrams.

532.72 = 4 2797

A forgotten effect in the theory of the thermo-gravitational method of separation. DE GROOT, S. R., HOOGENSTRAATEN, W., AND GORTER, C. J. *Physica, 's Grav.*, **9**, 923–4 (*Nov.*, 1942) *In French.*

532.72 = 4 2798

The thermo-gravitational method of separation applied to the case of an aqueous solution. DE GROOT, S. R., GORTER, C. J., AND HOOGENSTRAATEN, W. *Physica, 's Grav.*, **10**, 81–9 (*Jan.–Feb.*, 1943) *In French.*—An apparatus is described for applying the Clusius–Dickel method to solutions or liquid mixtures. Results obtained with $CuSO_4$ solution are given in terms of the separation of the two vertical surfaces of the apparatus for three different temperatures, and are in good agreement with the theory [Abstr. 2795, 2796 (1946)].

532.72 = 4 2799

Study of thermal diffusion in alcohol-water mixtures by the thermo-gravitational separation method. VAN VELDEN, P. F., VAN DER VOORT, H. G. P., AND GORTER, C. J. *Physica, 's Grav.*, **12**, 151–62 (*June*, 1946) *In French.*—The apparatus described in Abstr. 2798 (1946) was used at a temperature of about 40°C. Two methods of calculating the Soret coefficient and the constant of thermal diffusion are described, based on de Groot's theory [Abstr. 2796 (1946)]. At low alcohol concentrations the separation changes its sign when considered as a function of the distance between the plates. This is attributed to the "forgotten effect" [Abstr. 2797 (1946)].

532.72 = 3 2800

The theory of diffusion with special reference to characteristic (eigen) diffusion. LAMM, O. *Ark. Kemi Min. Geol.*, **18 B** (*No.* 2) *Paper* 5, 3 *pp.* (1944) *In German.*—Different expressions for the diffusion coefficients are first considered for the 2-component and then for the 3-component system, following which comes a treatment of characteristic (eigen) diffusion for these systems. The eigen diffusion should be independent of the mixture proportions, which, however, cannot be immediately concluded from the theory, but follows from elementary statistical considerations. H. H. HO.

532.72 : 541.183.33 : 532.612.4 *see Abstr.* 2791

532.72/.74 : 532.13 = 3 2801

Molar friction coefficients in solutions of associated and solvated substances with special consideration of diffusion theory. LAMM, O. *Ark. Kemi Min. Geol.*, **18 A** (*No.* 2) *Paper* 10, 11 *pp.* (1944) *In German.*—Equations for the calculation of friction coefficients are developed for two-component systems of which one component diffuses in dilute solution. It is shown that under ideal conditions, the average friction coefficient of the diffusion so computed agrees with that determined from the sedimentation velocity. This agreement, which is fundamental for molecular weight determination by diffusion and sedimentation, assumes that the partial specific volumes of the various associates or solvates are equal. Similar agreement is necessary for the validity of the Nernst diffusion theory between diffusion and ionic mobility under ideal conditions. In combination with the thermodynamics of the association and solvation processes, the derivation of the friction coefficients permits of a possible simple calculation of the diffusion coefficients. H. H. HO.

MECHANICS OF GASES 533

533.15 = 3 2802

Temperature gradients in the diffusion of streaming gases. WALDMANN, L. *Z. Naturforsch.*, **1**, 10–12 (*Jan.*, 1946) *In German.*—Two circular tubes 50 cm long with parallel axes are connected along their length by a common slot. If two gas mixtures of different composition stream along the tubes diffusion takes place through the slit normal to the flow. As in the non-static diffusion-thermo effect [Abstr. 401 (1946)] the heat convection does not balance and a temperature gradient is produced across the slit. It is shown that the temperature difference between the axes of the two tubes, averaged over their length, depends only on the gas compositions at the two ends and the thermal diffusion coefficient α. This average is measured by Pt wires along the axes. The experiment is simple and gives values of α for N_2–H_2 and N_2–O_2 mixtures in good agreement with values previously obtained. G. J. K.

533.15 = 3 2803

Temperature phenomena in diffusion. WALDMANN, L. *Z. Naturforsch.*, **1**, 59–66 (*Feb.*, 1946) *In German.*—Details of the diffusion thermo-effect [Abstr. 401, (1946)] are discussed, involving heat transfer αkT by diffusing molecules, where α is the thermal diffusion coefficient. Measurements of non-static effect were made with two cylinders containing mixtures placed end to end, by finding the temperature-time integral of a Pt wire at various levels in the cylinders. Various cylinder sizes were used, with a number of gas mixtures. The static effect was observed with the two gas mixtures streaming along parallel tubes with a common slit. Results for N_2–H_2 are given. G. J. K.

533.15 : 539.155.2 = 3 2804

The diffusion thermo-effect in many-component isotopic gas mixtures. WALDMANN, L. *Z. Naturforsch.*, **1**, 12–13 (*Jan.*, 1946) *In German.*—The theory of the diffusion thermo-effect for many gases is simplified for a mixture of isotopes. The thermal diffusion coefficients are then known except for a constant factor. Experiment determines this factor if the average molecular weight before and after diffusion is known. It is not necessary to know the individual concentrations of the components. G. J. K.

533.15 : 539.133 2805

Mutual diffusion of pairs of gases. WALL, F. T., AND KIDDER, G. A. *J. Phys. Chem.*, **50**, 235–42

(*May*, 1946).—A study is described of the mutual diffusion of pairs of the following gases: carbon dioxide, nitrous oxide, propane and ethylene oxide. Each of these compounds has a molecular weight of about 44, so that differences in the observed effects can be attributed primarily to size. A theoretical treatment precedes the description of the experimental method, essentially that of Boardman and Wild [*Proc. Roy. Soc.* (*London*) **A 162,** 511 (1937)] used at 25°C and 760 mm. The mutual diffusion coefficients for the pairs carbon-dioxide/propane and nitrous oxide/propane were nearly equal, which was to be expected from such physically similar molecules. Mean molecular diameters are calculated from the diffusion data. H. H. HO.

533.17 : 532.522 = 5 2806

On the efflux of saturated and superheated steam from Venturi tubes. CODEGONE, C. *Atti Accad. Torino*, **78** (*Tomo I*) 221–30 (1942–1943) *In Italian.*—An investigation to examine the validity of the law of similitude for ranges of values of the Reynolds number, *R*, obtained in hydraulic experiments, for the flow of saturated and superheated steam through Venturi tubes. The author considers also values of *R* beyond the hydraulic range. It appears that the coefficient of efflux increases slowly with *R*. V. C. A. F.

533.7 2807

Accommodation coefficients for heat conduction between gas and bright platinum, for nine gases between 80°K (or their boiling points) and 380°K. GRILLY, E. R., TAYLOR, W. J., AND JOHNSTON, H. L. *J. Chem. Phys.*, **14,** 435–40 (*July*, 1946).—Accommodation coefficients for O_2, NO, CO, CO_2, N_2O, CH_4, H_2 and He are computed from the $(1/K_a)$ *v.* $(1/P)$ slopes of thermal conductivity measurements [Abstr. 2321 (1946)]. The results are tabulated and collected in a graph for comparison with other results. Hydrogen rises towards a coefficient of unity with lowering temperature, but other gases drop steeply at low temperatures. The values differ slightly from Knudsen accommodation coefficients. Equations are derived which give the relationship between the reciprocal slopes, the temperature jump constants g' and the accommodation coefficients.

533.7 : 532.5 : 519.21 = 4 *see Abstr.* 2735

533.7 : 532.7 : 531.19 *see Abstr.* 2772

533.7 : 534.22 *see Abstr.* 2811

533.7 : 541.183 2808

Pressure dependence of accommodation coefficients. AMDUR, I.; MORRISON, J. L. *J. Chem. Phys.*, **14,** 339–42 (*May*); 466 (*July*, 1946).—This is explained for gases on metals by assuming that the accommodation coefficient varies linearly with the fraction of the surface covered with adsorbed gas. It is further assumed that the accommodation coefficient has a negligibly small value α_0 on a gas-free surface and an asymptotic value α_∞ on a saturated surface. The assumptions lead to an accommodation coefficient isotherm which reproduces the pressure dependence of 119 accommodation coefficient values for 10 gases on Pt with an average absolute deviation of 1·5%. Morrison, however, points out that minute quantities of impurity (O_2, H_2) in the inert gases would be adsorbed even at low pressure and could account for the fitting of the Langmuir isotherm [see Abstr. 4481 (1939)].

ACOUSTICS . VIBRATIONS 534

534.121.1 : 537.228.1 2809

Forced vibrations of piezoelectric crystals. EKSTEIN, H. *Phys. Rev.*, **70,** 76–84 (*July* 1 *and* 15, 1946).—The vibrations of anisotropic bodies under the influence of sinusoidally variable volume forces and boundary stresses are investigated. The displacement components are represented as sums of a system of "zero-order" solutions which solve approximately the free-vibration problem. The problem is reduced to a system of inhomogeneous linear equations which, for the free-body case, further reduces to the homogeneous system derived earlier [Abstr. 530, 2836 (1946)]. If the external forces are piezo-electric, the forces are no longer given explicitly because the electrical field distribution is known only if Maxwell's equations are solved simultaneously. However, if the pertinent piezo-electric constants are small, the field can be calculated approximately. As an example, forced vibrations of thin quartz plates between parallel electrodes are discussed.

534.22 2810

The velocity of sound: a molecular property. RICHARDSON, E. G. *Nature, Lond.*, **158,** 296–8 (*Aug.* 31, 1946).—A brief review is given of the relaxation theory of the influence of molecular properties of a gas on the velocity of sound propagation at high frequencies; it is emphasized that the theory has not yet been independently confirmed by experiment. No evidence has been found of dispersion of velocity in liquids, though there is evidence of enhanced scattering. The "second velocity of sound in He II" [Abstr. 1255 (1946)] can be explained on the simple basis of high thermal conductivity, which propagates temperature changes with a speed of acoustic order.

534.22 : 533.7 2811

Velocity of sound in mixtures of argon, helium and hydrogen at low temperatures. VAN ITTERBEEK, A., AND VAN DONINCK, W. *Proc. Phys. Soc., Lond.*, **58,** 615–24 (*Sept.*, 1946).—Measurements at a frequency of 524 kc/s as a function of pressure and at fixed temperatures near 90° and 20°A are described. From these data, information about the interaction between the gases in the mixtures is deduced, using the equation of state of Kamerlingh Onnes.

534.22 : 536.633.3 = 4 2812

Measurements of sound velocity in gaseous ammonia. VAN ITTERBEEK, A., AND LAUWERS, L. *Physica, 's Grav.*, **12,** 241–4 (*July*, 1946) *In French.*—Measurements were made as a function of pressure at 514·5 kc/s. Holst's value for the second virial coefficient was confirmed. The value of $(c_p/c_v)_p = 0$ computed from the measurements increases with decreasing temperature and becomes >1·333. This agrees with Giacomini [Abstr. 2122 (1925)], but the values are greater than his, probably due to a dispersion effect.

534.321.9 : 537.226.2 = 4 *see Abstr.* 2883

534.844.1 2813

The measurement of reverberation. TAK, W. *Philips Tech. Rev.*, **8,** 82–8 (*March*, 1946).—Theories

concerning reverberation in rooms and auditoria are discussed. Reverberation is considered as the sum of a number of damped characteristic vibrations. Due to interference, fluctuations are superposed upon the mainly exponential variation. The variation in intensity depends upon the shape and dimensions of the room, the distribution and properties of the absorption material, the position of the observer, the position of the source of sound, and the frequency spectrum of the sound produced, but when these factors remain constant it is completely reproducible. Several principles are indicated according to which apparatus can be constructed to study the variation in intensity during the reverberation and to characterize it by one or more parameters.

534.845.2 : 532.13 2814

Compressional viscosity and sound absorption in water at different temperatures. Fox, F. E., and Rock, G. D. *Phys. Rev.*, **70**, 68–73 (*July* 1 *and* 15, 1946).—The temperature dependence of the coefficient of absorption ($2\alpha\nu^{-2}$) of ultrasonic waves in water was measured from 0°C to 33°C. Values range from 137×10^{-17} at 0°C to 40×10^{-17} at 33°C. In particular, at 4°C, where the sound propagation is isothermal, the value 101×10^{-17} is found, and is to be compared with a shear viscosity contribution of 30×10^{-17}. Therefore the excess cannot be caused by the slowness of energy exchange between the internal and external degrees of freedom. The excess absorption is used to calculate the value of a new coefficient of compressional viscosity k, which is found to be to be 0·052 poise at 4°C and 0·026 poise at 20°C. A general discussion of the origin of sound absorption in liquids is included, with particular applications to recent measurements.

534.862 2815

The formation of stereophonic images. de Boer, K. *Phillips Tech. Rev.*, **8**, 51–6 (*Feb.*, 1946).—In this method of reproduction the sound is always heard from the same direction as that in which its source is seen, and a considerable improvement of quality results. The paper discusses the principles by which the coincidence of sound image and visual image can be attained. An artificial head with two microphones at the position of the ears is set up in the studio and sound recorded on film for each is reproduced via separate channels. The two loud-speakers are placed at either side of the screen in the projection room. The distance between them can be varied. Curves are given showing the relation between apparent and real angle of deviation of the sound. When it is desired to "project" images of sound "objects" of different sizes (large orchestras, stage plays, or small orchestras) in the same hall, the loud-speakers should in each case be placed at a different distance apart. This difficulty is overcome by a slight modification in the electrical connections, which results in an apparent increase or decrease in the distance apart of the loud-speakers. A. B. W.

OPTICS . RADIATION . SPECTRA 535

535.14:535.338.32 = 4 2816

Interaction between matter and radiation near the optical resonance frequencies. Lennuier, R. *Ann. Phys., Paris*, **20**, 91–110 (*Jan.–Feb.*, 1945) *In French.*—After a discussion as to how the time of emission is involved in the formula for the line breadth and intensity curve of emitted radiation, after excitation has ceased, the author considers its relation to the subsequent dispersion of the radiation by other atoms. If the incident radiation is widely different from the resonance energies of the dispersing atoms the mean life of these atoms is much shorter than the usual inverse of the decay constant. G. J. K.

535.231 : 771.448.1 2817

The determination of the initial temperature of a cooling total radiator from measurements of the spectral distribution of the energy emitted during cooling. Caldin, E. F. *Proc. Phys. Soc., Lond.*, **58**, 350–7 (*July*, 1946).—An expression is derived theoretically relating the initial temperature T_0 of a total radiator, cooling by radiation, to the spectral distribution of the total energy emitted during cooling (i.e. the variation with wavelength of the integral with respect to time of the energy flux at a given wavelength). This expression allows the determination of the initial temperature of such a cooling source (to which photographic flash bulbs, etc., provide approximations), from the spectral distribution of the energy received by a photographic plate or other recording device exposed to the source. This spectral distribution is compared with that of the energy flux from a total radiator at various fixed temperatures T_1; it is found that for each value of T_0 (between 2 500°K and 4 500°K) a value of T_1 can be found such that there is close agreement between the two spectral distributions. T_1 corresponds to the "temperature" cited in the literature for such sources. The relation $T_1 = 450 + 0{\cdot}7\,T_0$ is found to hold.

535.242.63 2818

Influence of the Stiles–Crawford effect on measurements with the Pulfrich photometer. Hansen, G. *J. Opt. Soc. Amer.*, **36**, 321–5 (*June*, 1946).—The Stiles–Crawford effect must be taken into account in the use of photometers of the diaphragm type, such as the Pulfrich. This can be done by making a correction to the reading. There is also a colour effect, however, and the amount of correction needed on this account is dependent on the state of adaptation of the observer's eye. J. W. T. W.

535.245.24.08 2819

A portable brightness distribution photometer. Thomas, E. R. *J. Sci. Instrum.*, **23**, 187–9 (*Aug.*, 1946).—Describes an instrument which gives on a c.r.t. a trace in which the ordinates are proportional to the brightness distribution across the field of view imaged by a lens on a scanning disc behind which is a 10-stage electron-multiplier photocell. The lower limit of brightness is 0·3 c/ft² uncorrected, or 3 c/ft² with the cell corrected to the sensitivity curve of the eye. J. W. T. W.

535.247.4 : 535.345.6 2820

The specification of a spectral correction filter for photometry with emission photocells. Preston, J. S. *J. Sci. Instrum.*, **23**, 211–16 (*Sept.*, 1946).—An aqueous solution of $CuCl_2$, Co ammonium sulphate and K dichromate is a useful filter for modifying the spectral response of certain types of emission photocell, so as to match the response of the standard (photopic) eye. This paper gives the spectral densities

of various concentrations of these three substances, in water. From these, the concentrations of the three components required to make a correction filter for a given photocell, can be calculated. An example of such a calculation is also given, and the practical performance of the filter is discussed.

535.31 = 4 2821

Analytical study of centred systems. DURAND, É. *Rev. Opt.* (*Théor. Instrum.*) **23**, 91–104 (*April–June*, 1944) *In French.*—An entirely mathematical treatment which directs attention to an old formula due to Cotes and applies it to a number of cases. A generalization of the Lagrange-Helmholtz formula for a point of the axis is given. Finally it is shown how a centred system can be represented by means of a matrix. A. H.

535.313 : 535.87 = 4 2822

Parabolic projector with spherical source. Intensity variation with position of source and with distance. FÉVROT, C. *Rev. Opt.* (*Théor. Instrum.*) **23**, 121–35 (*April–June*, 1944) *In French.*—This examination of the radiation reflected by a parabolic mirror is treated purely as an exercise in geometrical optics, assuming a perfect mirror and a spherical source obeying Lambert's Law. Attention is particularly directed to the character of the beam close to the mirror for source at focus, and away from focus. The results obtained are exhibited graphically and examples worked for specific cases. The effect of slight displacements is also examined. A. H.

535.313.2 : 535.833 = 4 2823

The problem of the correction of the aberrations of a mirror by means of an auxiliary refracting system. LAGRULA, J. *Rev. Opt.* (*Théor. Instrum.*) **21**, 140–50 (1942) *In French.*—It is pointed out that coma severely limits the useful field of parabolic mirrors and that correction of this by addition of an auxiliary refracting system would be useful. A mathematical treatment is given of a suggestion made by Ross, essentially the correction of the extra-axial aberrations whilst leaving a residue of spherical aberration. Various correcting systems are considered; the best is that using two pairs of lenses. The application to telescopes is discussed. A. H.

535.316 = 4 2824

The achromatism of optical systems. MARÉCHAL, A. *Rev. Opt.* (*Théor. Instrum.*) **21**, 151–5 (1942) *In French.*—Discusses mathematically the conditions for achromatism of a thin lens system situated between media of markedly different refractive indices. Practical applications considered are: the immersion of fragile galvanometer systems in organic liquids; and the case of monochromators using liquids for dispersion. A. H.

535.317.6 2825

The algebraic analysis of the higher-order aberrations of optical systems. BUCHDAHL, H. A. *Proc. Phys. Soc., Lond.*, **58**, 545–75 (*Sept.*, 1946).—The behaviour of an optical system is known if the position of the point of intersection of an arbitrary ray passing through the system with any chosen plane of reference can be determined. In this paper tangential aberrations of any order are defined in terms of the distance of this point from an ideal image point, using elementary methods only. It is shown how these aberrations may be computed in practice without the use of any trigonometrical traces. As a practical example, the computations necessary for the determination of the complete primary and secondary aberrations and of the tertiary spherical aberration are given in detail for the case of a Cooke triplet. The information so obtained is compared with that yielded by strict trigonometrical tracing, illustrating the good agreement between them and the simplicity of the computations involved.

535.317.9 2826

On the theory and computation of an aspherical surface. GLANCY, A. E. *J. Opt. Soc. Amer.*, **36**, 416–23 (*July*, 1946).—A method is described for calculating the figuring of a surface of a lens system to correct spherical aberration. Rays are traced backwards from the desired aberration-free image point (at "guessed" inclinations) to a chosen surface, the rays through this and the rest of the system being matched by successive approximation. Consideration of optical path differences leads to the desired form of surface. The method can be used for the calculation of Schmidt lenses. A numerical example is given. H. H. HOP.

535.32 : 541.65 *see Abstr.* 2986

535.321 : 537.363 2827

Optical methods in electrophoresis. Principles, apparatus, determination of apparatus constants, and application to refractive index measurements. LONGSWORTH, L. G. *Industr. Engng Chem.* (*Analyt. Edit.*) **18**, 219–29 (*April*, 1946).—The optical equipment developed at the Rockefeller Institute for the quantitative study of refractive index gradients in solution is described, together with suggestions for its installation and adjustment. It is based on the Foucault–Toepler schlieren method, and incorporates a scanning modification and the cylindrical lens arrangement of Philpot and Svensson. The chief use of the apparatus is to record the moving boundary patterns in the electrophoretic analysis of proteins by the Tiselius method. The precise measurement of refractive index differences in aqueous solutions is also described.

535.323–15 : 535.345.1–15 : 771.351 = 4 2828

Study of the refractive indices and transparency of optical glasses in the photographic infrared (to 10 000 Å). MARQUET, M. *Rev. Opt.* (*Théor. Instrum.*) **21**, 207–34 (1942) *In French.*—Photographic objectives for use in the visible region not being suitable for infra-red work because of marked spherical and chromatic aberration, an experimental study is made of a considerable number of glasses for the region 7 000–10 000 Å, with a view to obtaining data which will facilitate the selection of suitable glasses and permit of the calculation of objectives. Details are given of the experimental technique employed, also tables of the data obtained. It is found that values for the infra-red cannot be obtained by extrapolation from visible data and it is concluded that it is impossible to produce large aperture lenses suitable for use in both regions. Details are also given of a complementary study of the transmission of the glasses in question for this infra-red region. A. H.

535.326 = 5 2829

Propagation, according to geometrical optics, of a monochromatic light ray in an isotropic heterogeneous medium. ODONE, F. *Nuovo Cim.*, **19**, 157–68 (*May–July*, 1942) *In Italian.*—A mathematical treatment of the geometry of a simple ray through a medium of which the refractive index varies from point to point. The analysis is perfectly general, but the results are applied to a medium in which the equirefractive surfaces are parallel planes and to Bouguer's case in which they are concentric circles. J. W. T. W.

535.33 : 545.82 2830

Spectroscopy, past, present, and future. MEGGERS, W. F. *J. Opt. Soc. Amer.*, **36**, 431–48 (*Aug.*, 1946).—A short history of the development of spectroscopy is given, and references (378 in all) are given for published spectral analyses, and nuclear moment determinations. The results of the latter are collected in a table, and the former are also tabulated, by element and ionization order, to show the existing knowledge and unexplored territory. The development of spectrochemical analysis is discussed, and light-sources and methods of analysis are listed. The article ends with a discussion of future possibilities in spectroscopy. Many spectra are partly or completely unknown, the use of the Zeeman effect for the analysis of complex spectra must be developed, with improvement of resolving power. The radio frequency method of observing nuclear moments is only just being introduced.

535.33.072 : 535.417 = 4 *see Abstr.* 2849

535.338.1 : 536.46 2831

The light emission from "cool" and "blue" flames in the two-stage process of ignition of ether- and acetaldehyde-oxygen mixtures. TOPPS, J. E. C., AND TOWNEND, D. T. A. *Trans. Faraday Soc.*, **42**, 345–53 (*March–April*, 1946).

535.338.1 : 537.531 2832

On the emission spectra of some oxides and pure elements in the soft X-ray region. COSTER, D., AND HOF, S. *Physica, 's Grav.*, **7**, 655–68 (*July*, 1940).—The *K*-emission spectra of Be and B and the *L*-emission spectra of Al and Si of the pure elements and their oxides were investigated with a vacuum grating spectrograph. For metallic Be and Al a broad line with a sharp edge on the short wavelength side was found, typical of a metallic conductor. The same was found with a pure B sample, which proves that this element has to be regarded as a conductor. The emission line of Si looks more like that of a semi-conductor or insulator. The oxides of these elements, however, give broad emission lines which are typical for totally filled valency-bands. For B and Si the short wavelength side of the lines has a higher frequency for the oxides than for the metals. In the case of Be and Al the reverse is true. It is reasonable to assume that these lines consist of two broad lines which partly overlap. In the case of BeO a new broad line of smaller frequency has been found, which may be regarded as $K \rightarrow L$ transition. In the case of B_2O_3 a boron line is found, which may be interpreted in the same sense.

535.338.32 : 535.14 = 4 *see Abstr.* 2816

535.338.4 = 4 2833

Remarks on some cases of predissociation. ROSEN, B. *Physica, 's Grav.*, **12**, 184–8 (*July*, 1946) *In French.*—The effect of predissociation in the lower state of a band system is discussed. The $^2\Sigma$—$^2\Sigma$ system of AlO serves as an example, and it is shown that the lower state suffers predissociation of type 1*b*, with the dissociation limit of the perturbing state lying 0·93 e.v. above $v'' = 0$, $K = 0$ of the lower $^2\Sigma$ state. The ground state of AlO must therefore dissociate to one or more excited atoms, probably to Al(^{2}P) + O(^{1}D). P. Migeotte's study of NO bands in emission and absorption confirms that the $v = 1$ level of the C$^2\Sigma$ state is predissociated and that the levels $v = 1$ and 2 suffer vibrational perturbations. This confirms Flory and Johnston's work on the photochemical decomposition of NO. Phenomena observed in the spectrum of Te_2 are interpreted as "accidental vibrational predissociation." The analogy between the spectra of S_2, Se_2 and Te_2 is thereby strengthened. A. G. G.

535.338.4–31 : 539.133 2834

The rotational analysis of some bands of the near ultra-violet system (D–X) of silicon monosulphide. BARROW, R. F. *Proc. Phys. Soc., Lond.*, **58**, 606–15 (*Sept.*, 1946).—An analysis has been made of the 0,1, 0,2, 0,3, 0,4, and 1,5 bands of the system ($\nu_e \simeq 35\,030$ cm^{-1}). The transition responsible for the production of the band-system is of the type D $^1\Pi - $ X $^1\Sigma$. The rotational constants have been derived from experimental observations of absorption and emission. $B_v'' = 0{\cdot}3036 - 0{\cdot}0014_9\ (v'' + \frac{1}{2})$ for the ground state, and $B_v' = 0{\cdot}2664 - 0{\cdot}0020_5\ (v' + \frac{1}{2})$ for the upper state. Λ-type doubling in the upper $^1\Pi$ state is negligibly small, at least up to $J = 100$. The values of the equilibrium internuclear distances are $r_e'' = 1{\cdot}929$ Å and $r_e' = 2{\cdot}059_5$ Å. A brief discussion of the results is given.

535.339 = 4 2835

High luminosity monochromator. MERLAND, A. *Rev. Opt. (Théor. Instrum.)* **23**, 111–20 (*April–June*, 1944) *In French.*—Full details are given of a high luminosity, high dispersion (7 600–3 934 Å = 23°) monochromator using a Pellin–Broca type prism (angle = 120°) containing ethyl cinnamate. A totally reflecting mirror immersed in the liquid and used to control the direction of the radiation leaving the prism also cuts down loss of light. The apparatus was designed for the study of absorption bands of solutions of the rare earths. A. H.

535.341 : 535.651 2836

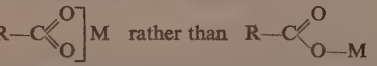
A simple photo-electric absorptiometer. CLAYSON, H. R., AND SCOTT, B. A. *J. Soc. Chem. Ind., Lond.*, **65**, 97–100 (*April*, 1946).

535.342 : 539.166 = 4 *see Abstr.* 2935

535.343–15 : 541.61 = 4 2837

Infra-red absorption spectra of metallic salts of mono- and dibasic acids (aliphatic and aromatic); symmetry and structure of the carboxyl group. DUVAL, C., LECOMTE, J., AND DOUVILLE, F. *Ann. Phys., Paris*, **17**, 5–72 (*Jan.–Feb.*, 1942) *In French.*—The spectra of about 100 powdered salts (formates, acetates, malonates, benzoates, etc.) have been studied in the region 600 to 1 600 cm^{-1}. The bands form easily recognizable groups, whose frequencies are not entirely independent of the metal, but generally only vary within small limits. In attempting to

assign the bands to definite modes of vibration, use has been made of the fact that the frequencies characteristic of the C chain are more affected by changing the metallic substituent than are the frequencies associated with vibrations within the carboxyl group. Comparison is also made with similar structures in which the carboxyl group is replaced by other groups, such as Me. The symmetrical valence vibration of the COO group and the corresponding antisymmetrical vibration (which has a slightly higher frequency than the first) lie in the region 1 280–1 550 cm^{-1}, while the symmetrical deformation vibration is between 800 and 950 cm^{-1}. It is shown that the carboxyl group has an angular structure, the angle OCO being between 110° and 130°. The binding forces C–O and O–O are of the same order of magnitude and vary between 7 and $7{\cdot}7\times10^5$ dynes/cm. It is better to write the structure of these salts in the form



where M denotes a monovalent metal atom. The spectra correspond closely with those in which the COO group is replaced by a NO_2 group. There is, however, little similarity in the spectra of the acids and their salts. A. G. G.

535.343.4–14 : 621.396.11 2838

The absorption of one-half centimeter electromagnetic waves in oxygen. Beringer, R. *Phys. Rev.*, **70**, 53–7 (*July* 1 *and* 15, 1946).—The absorption was measured for O_2 and O_2–N_2 mixtures as a function of pressure. The apparatus employed a klystron oscillator, crystal-rectifier frequency-multiplier, wave-guide absorption path, and crystal detector. The measured values are in agreement with the theory of Van Vleck both as regards the absolute value of the absorption (which is as great as 67 db/km at the band centre for pure O_2 at a pressure of one atm.) and the dependence on pressure.

535.343.4–15 : 539.133 *see Abstr.* 2928

535.343.4–31 2839

Ultra-violet absorption band-systems of SiS, SiSe and SiTe. Vago, E. E., and Barrow, R. F. *Proc. Phys. Soc., Lond.*, **58**, 538–44 (*Sept.*, 1946).—A new ultra-violet band-system, B–X, of each of the molecules has been observed in absorption at 800–1 000°C, and vibrational analyses have been done. The D–X systems, already known in emission, have also been photographed in absorption. These observations have extended the D–X systems of SiSe and of SiTe and have led to somewhat improved values of the vibrational constants. The results are given in tables.

535.345 : 535.434 : 541.182.6 = 398 2840

Investigations on the transmission of light through suspensions. Andreasen, A. H. M. *Tekn. Tidskr.*, **76**, 467–74 (*May* 11, 1946) *In Danish.*—A series of measurements of extinction coefficients and turbidity on monodisperse suspensions of $BaSO_4$ in aq. 0·003 M Na pyrophosphate (10 g/l) are described. A Pulfrich photometer with red, green or blue filter was used, and the particle sizes in the samples were varied between $0{\cdot}15\,\mu$ and $4\,\mu$ by addition of Na citrate. Concentration was varied by 4–5 successive dilutions to double the volume. Lambert–Beer's law is valid for particle sizes $<0{\cdot}5\,\mu$ and $>1{\cdot}5\,\mu$, between these values the extinction coefficient increases with dilution and the specific extinction is given as $\varepsilon = \lim_{c=0} \varepsilon/c$ where c is cm^3 per litre solution. Some approximately monodisperse suspensions (MnO_2, Cr oxide green) were also examined, with different mean particle size, and suspensions of MnO_2 with particle sizes $<0{\cdot}15\,\mu$ were prepared by extraction with pipette at various depths of a polydisperse suspension which was allowed to set for 15–30 days. Here, also, there is a max. of the extinction coefficient at a definite particle size, $0{\cdot}17\,\mu$ for red light, $0{\cdot}07\,\mu$ for green and $0{\cdot}06\,\mu$ for blue. The results of all measurements are given in tables and graphs. J. A. W.

535.345.1–15 : 771.351 :
535.323–15 = 4 *see Abstr.* 2828

535.345.6 : 535.247.4 *see Abstr.* 2820

535.352 2841

Determination of absolute efficiency for excitation by electron-impact of the lines λ = 5 945, 6 142, 6 334 and 6 402 of neon. Milatz, J. M. W., and Wouden-berg, J. P. M. *Physica, 's Grav.*, **7**, 697–704 (*Oct.*, 1946).

535.354 : 537.523.4 *see Abstr.* 2895

535.354 : 537.568 2842

Recombination and the long duration of the Balmer spectrum. Zanstra, H. *Proc. Roy. Soc. A*, **186**, 236–41 (*July* 9, 1946).—A discussion is given of an experiment by Lord Rayleigh [Abstr. 2604 (1944)], who found that the time of relaxation of the Balmer series of H excited by an electrodeless discharge is of the order of 10^{-5} sec. Assuming that the luminosity is due to recombination of electrons with protons, it is now shown that Kramer's theory yields half-value periods $>10^{-5}$ sec under the special experimental conditions. The difficulties of the theory, pointed out by Cillié [Abstr. 4066 (1936)] and by Page [Abstr. 3072 (1946)], are discussed. The problem of recombination still presents many contradictions. L. S. G.

535.37 : 548.73 = 3 *see Abstr.* 2998

535.371 = 3 2843

On a group of complex phosphors with mixed activators. Brauer, P. *Z. Naturforsch.*, **1**, 70–8 (*Feb.*, 1946) *In German.*—A continuation of earlier work [Abstr. 749 (1940)]. Alkaline earth sulphide phosphors with Sm and another activator showed abnormal behaviour compared with the same matrix activated by these elements singly. The second activator may be Pb in CaS, Mn, Ce, Pr or Eu in SrS. The samples were excited by light, after 2 sec the stored energy was expelled by heating or by infra-red radiation at room temperature. Spectrograms of the emission were made, with automatic repetition up to hundreds of times to give the required photographic density. SrS . Ce gave an approximately equal amount of light, and in the same spectral band, by either expulsion process. SrS . Sm responded to heating only. SrS . CeSm on heating gave only the Sm spectrum, in amount less than from SrS . Sm; by infra-red it gave only the Ce spectrum, in amount greater than from SrS . Ce. Partial exhaustion of the available light by infra-red diminished the amount expelled, in the other spectrum, by subsequent heating. The two actions occurred independently at elevated temperatures. Spectral sensitivity in the infra-red

effect was the same for all phosphors with Sm as one activator. The greater light output produced by infra-red compared with heating was typical, whereas in simple phosphors heating never produces less than infra-red. A short theoretical discussion is given in terms of trapped electrons. The phenomena are probably related to the "killer" effect of some elements in other phosphors. S. T. H.

535.371 2844

On infra-red sensitive phosphors. URBACH, F., PEARLMAN, D., AND HEMMENDINGER, H. *J. Opt. Soc. Amer.*, **36**, 372–81 (*July*, 1946).—These materials are subject to "stimulation," or the infra-red acceleration of the emission of their stored energy. SrS . Bi and CaS . Pb required to be stored and used at low temperatures, but alkaline earth sulphides with two activators were more convenient and efficient. The dominant activator determines the emission spectrum; stimulation is sensitized by an auxiliary activator determining the spectral distribution of this sensitivity ("stimulation spectrum"). The auxiliary activator also diminishes the apparent after-glow due to the dominant activator by slowing down the rate of emission, but increasing the total storage. The spectrum of the auxiliary activator may appear in spontaneous after-glow and in thermoluminescence. If the phosphor has only the auxiliary activator, the after-glow is extinguished by infra-red or other wavelengths, and this effect has a spectral distribution identical with the stimulation spectrum observed in the presence of a dominant activator. In SrS the dominant class includes Ce, Eu, Cu and Mn, and the auxiliary Sm (peak of stimulation 1·02 μ), Bi (0·89 μ), Sn (0·63 μ), Fe, Ni and V. In SrS . SmBi the dominant activator is Sm. These results emphasize the importance of traces of impurities in phosphors. Close control of the atmosphere in which preparation and firing occurred were necessary to ensure reproducibility. Cation interchange between matrix and flux was demonstrated, and the effects of sulphate and chloride ions. The most efficient phosphors were SrS . EuSm with CaF_2 flux, and SrS . CeSm with LiF flux, Both gave a total emission by stimulation of about 10^{17} quanta/cm³, with a quantum efficiency of about 1 visual quantum/300 infra-red quanta. S. T. H.

535.372 2845

Transfer of energy between centres in zinc sulphide phosphors. KLASENS, H. A. *Nature, Lond.*, **158**, 306–7 (*Aug.* 31, 1946).—An explanation is put forward for the observed temperature-dependence of the separate emission bands of phosphors with two or more activators. Energy is transferred from impurity centres of one kind to those of another by "holes" travelling through the lattice, and equations are given for the temperature-dependence of such an effect, from which the effects on emission spectrum and afterglow can be deduced.

535.375.5 2846

Fine structures in Raman spectra. RANK, D. H., AND VAN HORN, J. A. *J. Opt. Soc. Amer.*, **36**, 454–9 (*Aug.*, 1946).—Cylindrical lenses used in conjunction with powerful grating spectrographs have achieved a resolving power approximately one order of magnitude greater than is easily feasible with prism spectrographs for the photography of Raman spectra. Fine structures due to the isotopes of Cl have been observed in the spectrum of CCl_4 and $CHCl_3$. The $\Delta\nu = 217$ cm^{-1} and $\Delta\nu = 314$ cm^{-1} frequency shifts of CCl_4 are not resolvable. The "difference bands" arising from return transitions from the Fermi resonance doublet in the CCl_4 spectrum have been found. These bands appear with approximately the intensity calculated by Horiuti [Abstr. 4513 (1933)]. Fine structure of the totally symmetric frequency in the benzene spectrum has been measured under high dispersion. The results of these measurements are in good agreement with those of Langseth and Lord [Abstr. 2910 (1938)].

535.39 : 535.5 = 4 *see Abstr.* 2853

535.39.07 = 4 2847

Apparatus for the measurement of reflexion and transmission factors and the rapid study of semi-transparent metallised sheets. TERRIEN, J. *Rev. Opt. (Théor. Instrum.)* **23**, 105–10 (*April–June*, 1944) *In French.*—Description of simple apparatus for the measurement of the reflexion factors, etc., of thin metallic films produced by evaporation *in vacuo*. The original beam of light is split into two and by means of a pair of mirrors directed on to the film from opposite sides. The reflected or transmitted beams are collected by two more mirrors and directed on to a photocell. By means of four screens or shutters, one in connection with each mirror, the light falling on to the photocell can be restricted to that reflected from one or other surface or to that transmitted. An accuracy of 1% is claimed to be easily obtainable. A. H.

535.417 = 4 2848

On the Fabry–Perot interferometer. Importance of surface defects. DUFOUR, C., AND PICCA, R. *Rev. Opt. (Théor. Instrum.)* **24**, 19–34 (*Jan.–March*, 1946) *In French.*—A study is made of the effects produced by various instrumental defects—diffusion, plate curvature, surface irregularities. A mathematical treatment is developed and is shown to account fully for the observations. A simple method is indicated for distinguishing between effects due to instrumental causes (surface defects, diffusion) and spectral causes (non-resolved satellites, continuous background). A. H.

535.417 : 535.33.072 = 4 2849

Use of the Fabry–Perot interferometer for the study of feeble satellites. DUFOUR, C. *Rev. Opt. (Théor. Instrum.)* **24**, 11–18 (*Jan.–March*, 1946) *In French.*—Heavily silvered mirrors are best. Low luminosity due to reflection at the first surface is overcome by having a clear space for entry. The methods of use, and the advantages obtained, are discussed at length. Attention is also given to the use of long tube "end-on" sources. A. H.

535.417 : 548.572 2850

Further interferometric studies with mica. New multiple-beam fringes and their application. TOLANSKY, S. *Proc. Roy. Soc. A*, **186**, 261–71 (*July* 9, 1946).—Three multiple-beam interference methods are described for studying the surface topography and internal structural features of thin slips of mica. These involve (*a*) new white light interference fringes,

(*b*) an adaptation of monochromatic Fizeau fringes, (*c*) monochromatic non-localized fringes of high dispersion. The properties of (*a*) are discussed. They provide a powerful method for investigating interferometric properties of thin films. The directions of surface contours and of cleavage steps can be determined, and surface angles of only 0·003 min of arc can be measured, over a length of 1 cm. The fringes give information about surface contours, local variations in chemical composition, local occlusions, growth nuclei, birefringence, nature of cleavage surface, etc. The precision is such that the molecular lattice spacing of mica normal to the cleavage direction can be evaluated. The fringes of type (*c*) also reveal cleavage steps and birefringence. L. S. G.

535.42 2851

The diffraction of light by a large number of circular objects. REESINCK, J. J. M., AND DE VRIES, D. A. *Physica, 's Grav.*, **7**, 603–8 (*July*, 1940).—A large number of circular holes were drilled "arbitrarily" in an opaque plate. The diffraction intensity distribution was not simply a multiple of the scattering by one hole; but had an additional minimum round the direct ray, caused by the presence of some regularity in the distribution of the holes. The radial distribution function for the given plate was determined experimentally, and showed a periodicity responsible for the effect. The theoretical distribution function of not-overlapping holes is calculated from statistical principles. It shows some regularity due to "steric hindrance." This regularity is, however, much smaller than in the preceding case and so is its influence on the diffraction pattern.

535.434 : 541.182.6 : 535.345 = 398 *see Abstr.* 2840

535.435 : 541.24 2852

A light scattering investigation of cellulose acetate. STEIN, R. S., AND DOTY, P. *J. Amer. Chem. Soc.*, **68**, 159–67 (*Feb.*, 1946).—Instruments are described for the absolute measurement of turbidity and for the measurement of the angular distribution of intensity of scattered light. From measurements of turbidity, dissymmetry, refractive index increment and depolarization, the molecular weights of four cellulose acetate fractions have been calculated and found to agree with those measured by other means within 8%. The complications in the method when the molecules are large enough to give a dissymmetrical angular intensity distribution are discussed. The empirical constant μ, characterizing deviations from van't Hoff law behaviour, is found to be $0{\cdot}45 \pm 0{\cdot}01$ by light scattering measurements as compared with the value $0{\cdot}43 \pm 0{\cdot}005$ based on osmotic pressure measurements on the system cellulose acetate/acetone. Angular variation in intensity is in agreement with theoretical prediction. Comparison of measured with predicted dissymmetry for a rod or random coil molecule indicates that the cellulose acetate molecule in acetone solution is rather extended up to a molecular weight of about 80 000 and at higher molecular weights the molecule may coil back on itself. This effect increases with increasing molecular weight. W. R. A.

535.5 : 535.39 = 4 2853

Elliptical reflexion and the optical study of thin layers. DE MALLEMANN, R., AND SUHNER, F. *Rev. Opt. (Théor. Instrum.)* **23**, 20–38 (*Jan.–March*, 1944) *In French.*—A lengthy survey is given of the theory and the derivation of formulae for the state of polarization of the reflected light in the case of two media in contact. The general case is considered for both isotropic and anisotropic media, after which the special case of thin layers is dealt with (from a thickness of 10 Å up to several microns). The argument is on geometrical lines. Details are also given of the experimental determination of the thickness and refractive index of thin layers, deposited on solids, using elliptically polarized light. A. H.

535.551 : 541.64 : 532.133 *see Abstr.* 2785

535.568.1 = 4 2854

Critical study of the errors produced in polarimetry when using bare sheets of mica. RABINOVITCH, J. *Rev. Opt. (Théor. Instrum.)* **25**, 36–44 (*Jan.–March*, 1946) *In French.*—An entirely mathematical treatment of the measurement of birefringence by Chauvin's method. Stress is laid on the importance of reducing very considerably the reflecting power of the surface when dealing with thin sheets. A. H.

535.64 2855

Colour equations. BOUMA, P. J. *Physica, 's Grav.*, **12**, 189–94 (*July*, 1946).

535.64 : 612.843.32 2856

Mathematical relationship between the colour vision systems of trichromats and dichromats. BOUMA, P. J. *Physica, 's Grav.*, **9**, 773–83 (*Sept.*, 1942).

535.642.1 2857

The basic sensation curves of the three-color theory. STILES, W. S. *J. Opt. Soc. Amer.*, **36**, 491–2 (*Aug.*, 1946).

535.651 : 535.341 *see Abstr.* 2836

535.661.3 2858

The cellulose-dyestuff complex. The intensity of light reflected from dyed fibres. PRESTON, J. M., AND TSIEN, P. C. *J. Soc. Dy. Col., Bradford*, **62**, 242–8 (*Aug.*, 1946).—An explicit relation between reflected light intensities and dye concentrations is derived from a proposed model and gives a reasonable fit to experimental measurements on dyed fibres.

535.833 : 535.313.2 = 4 *see Abstr.* 2823

535.87 = 4 2859

Geometrical stability of metal mirrors. DE GRAMONT, A. *Rev. Métall.*, **42**, 254–7 (*Aug.*, 1945) *In French.*—An interferometric method is used to explore the contours of various mirrors of invar, elinvar, bronze on beryllium, steel and aluminium. Optical flats of invar acquired a concavity of nearly 1 μ on a sample 50 mm in diameter during a period of 8 years. Similar mirrors of elinvar lost their shape about 3 times as rapidly. The other metals used seem to be more satisfactory, but long term tests are not yet completed. N. C.

535.87 : 535.313 = 4 *see Abstr.* 2822

535.88 : 778.552 2860

Optical problems of the rotating-prism cinematograph projector. KUDAR, J. *Proc. Phys. Soc., Lond.*, **58**, 598–605 (*Sept.*, 1946).—The most characteristic optical aberration in the rotating-prism non-intermittent cinematograph projector, the non-linearity of the image shift, can be eliminated by a

suitable periodic variation of the direction of the illuminating beam. In addition to a description of this method, other aberrations of the image formation by the rotating prism are discussed, such as the prismatic astigmatism and the tangential and sagittal prismatic coma.

HEAT . THERMODYNAMICS 536

536.2.02 2861

Thermal inductance. BOSWORTH, R. C. L. *Nature, Lond.*, **158**, 309 (*Aug.* 31, 1946).—The analogy between electrical and thermal resistance is extended to include inductance, which is represented (for a fluid system) by the kinetic energy stored in the convection currents of the fluid. An experiment is described to demonstrate its existence. The temperature difference between the surface of a wire and the bulk of the fluid in which it is immersed was measured by thermocouples, and plotted with respect to the time elapsing after the starting of a heating current in the wire. Steady equilibrium states were reached in 2–10 min, but the temperature difference always rose above its final value before settling down. The graph resembles an electrical circuit containing resistance, capacitance and inductance, less than critically damped.

536.24 2862

Some simplified heat transfer data. *Inst. Fuel Bull.*, 171–4, 184 (*April*, 1946).—References, corrigenda and discussion of a paper by Fishenden and Saunders [Abstr. 1062 (1946)].

536.413 : 531.252.2 = 397 *see Abstr.* 2775

536.42 : 541.183.55 *see Abstr.* 2978, 2979

536.423 2863

Free evaporation into air of water from a free horizontal quiet surface. BOELTER, L. M. K., GORDON, H. S., AND GRIFFIN, J. R. *Industr. Engng Chem.*, **38**, 596–600 (*June*, 1946).—[See Abstr. 4600 (1398)]. Curves and equations are given for the evaporation of distilled water from a surface (12 in diameter) within the temperature range 63–200°F into quiet air at 65–80°F and 54–98% R.H. In extension of previous work a quieting chamber and a spherical glass float evaporimeter are employed. W. R. A.

536.423 : 536.71 2864

An equation for the line of saturation of liquids and vapours. HAGGENMACHER, J. E. *J. Amer. Chem. Soc.*, **68**, 1123–6 (*June*, 1946).—An expression in terms of vapour volume, liquid volume, pressure and temperature, which affords a mathematical expression of the line of saturation, and expressions for the sum and difference of the volumes of vapour and saturated liquid have been developed. The relationship is more accurate for the region of the line of saturation than those of van der Waals or Berthelot when tested for 58 substances, for each of which the constants of the equation have been evaluated. W. R. A.

536.423.1 : 532.7 = 4 *see Abstr.* 2793

536.441 2865

A theory of the critical temperatures of the normal paraffins. CORNER, J. *Proc. Camb. Phil. Soc.*, **42**, 328–36 (*Oct.*, 1946).—A simple model of independent curled-up molecules is examined theoretically. The critical temperature is found to be of the right order of magnitude but does not increase sufficiently rapidly with the size of the molecule. The Onnes constant and the critical density show the discrepancies expected from the theoretical equation of state, and the former also has an incorrect dependence on molecular weight. In the critical region, therefore, the paraffins cannot be regarded as an assembly of independent molecules, curled up in the way expected at high temperatures and low densities.

536.46 : 535.338.1 *see Abstr.* 2831

536.48 : 531.19 : 530.145 = 5 *see Abstr.* 2765

536.48 : 536.631 *see Abstr.* 2868

536.48 : 536.71 2866

Isotherms of helium gas from 2·7 to 1·7°K. KISTEMAKER, J., AND KEESOM, W. H. *Physica, 's Grav.*, **12**, 227–40 (*July*, 1946).—Experimental results are reported. The behaviour of the second virial coefficient B is well represented by $B = -387/T + 15$ cm³/mol (uncertainty 5%), in the temperature region from 1·8 to 60°K. The experimental values of BT / lie between those calculated by de Boer and Michels [Abstr. 2580 (1939)] and those derived from the A potential of Buckingham, Hamilton and Massey [Abstr. 2678 (1941)]. εr_0^2 has a value of about 120×10^{-32} erg cm², the potential minimum of two atoms being characterized by its depth ε and by the distance r_0 between the nuclei.

536.48 : 536.71 *see Abstr.* 2874

536.48 : 538.24 *see Abstr.* 2914

536.48 : 538.632 *see Abstr.* 2922

536.483 2867

A helium cryostat. COLLINS, S. C. *Phys. Rev.*, **70**, 98–9 (*July* 1 *and* 15, 1946).

536.631 : 536.48 2868

Specific heat of $Gd_2(SO_4)_3 . 8H_2O$ between 1·0 and 4·0°K. VAN DIJK, H., AND AUER, W. U. *Physica, 's Grav.*, **9**, 785–99 (*Sept.*, 1942).—New accurate measurements in zero magnetic field are presented and used to obtain information on the electronic part of the specific heat. The experimental results combined with theoretical considerations provide good evidence that in a predominantly cubic field the eightfold degenerate basic state of the Gd^{+++}-ion is split up into two doubly degenerate levels and one quadruply degenerate level between them; the quadruple level lies nearer to the lower doublet, and the ratio of the spacings is 3 : 5. δ/k amounts to $1{\cdot}35 \pm 0{\cdot}01$°K.

536.631 : 548.0 = 3 2869

Low temperature investigations. I. The molecular heat of lithium fluoride between 18° and 273·2° abs. CLUSIUS, K. *Z. Naturforsch.*, **1**, 79–82 (*Feb.*, 1946) *In German.*—The variation with temperature between 18° and 273·2°A, of the molecular heat of an ionic crystal, in this case LiF, has been investigated, using a vacuum calorimeter. The Debye continuum theory holds only qualitatively. A single characteristic temperature, θ_D, does not suffice to describe accurately the variation of the molecular heat. The value of θ_D passes through a minimum of 607° at 80°A, rising to 648° at 273·2°A and to 752° at 18°A. The average atomic heat, which in the case of LiF is half the molecular heat, falls to 0·0065 cal/g atom.

This is about 0·001 of the value at room temperature. LiF is the most suitable material for confirming the applicability of the Born lattice theory to the molecular heat of ionic crystals. A. J. M.

536.633.3 : 534.22 = 4 *see Abstr.* 2812

536.7 = 4 2870

Thermodynamics of fluids. DE BEAUREGARD, O. C. *C.R. Acad. Sci., Paris*, **222**, 590–2 (*March* 11, 1946) *In French.*—The proper mass of a portion of fluid subjected to forces at its boundary is not constant and the 4-dimensional integrals involved in the expression of this fact lead to a definition of an invariant proper-density of thermal energy. It is also shown how the quantity of heat in the portion of fluid, the entropy and the temperature can be expressed as 4-dimensional invariants. G. C. McV.

536.7 2871

The thermodynamic properties and potential energy of solid argon. II. RICE, O. K. *J. Chem. Phys.*, **14**, 321–4 (*May*, 1946).—In an earlier paper [Abstr. 2178 (1944)] a relation was derived from the available experimental data giving the Debye characteristic temperature of solid A as a function of a (the interatomic distance) or V (the molal volume of the solid). This relation was not consistent with the usual Grüneisen assumption, which for a small range of volumes may be written approximately $-(\Theta)^{-1}d(\Theta)/dV=$ constant. In this paper it is shown that the Grüneisen assumption, with the constant set equal to 0·18 mole/cm³, is reasonably consistent with the experimental data. On this basis a new relation between the potential energy E_p of solid A and a is derived. Most of the earlier conclusions are unaltered, and difficulties are avoided when application is made to liquid A. [Abstr. 2872 (1946)].

536.7 2872

The thermodynamic properties of liquid argon. RICE, O. K. *J. Chem. Phys.*, **14**, 324–38 (*May*, 1946).—The thermodynamic properties and equation-of-state data of liquid argon are interpreted in terms of a partition function previously derived [Abstr. 822 (1944)]. This partition function has a part due to vibratory motion of the atoms in the liquid and a part due to translational motion. The properties of the liquid can be correlated rather well with those of the solid [Abstr. 2871 (1946)].

536.7 : 539.388.8 : 541.182.5 *see Abstr.* 2968

536.7 : 541.183.3 *see Abstr.* 2972, 2973, 2974

536.7 : 548.73 : 531.19 *see Abstr.* 2773

536.71 2873

Generalised Beattie–Bridgeman equation of state for real gases. SU, G.-J., AND CHANG, C.-H. *J. Amer. Chem. Soc.*, **68**, 1080–3 (*June*, 1946).—A generalized form is proposed which holds for 17 gases with a deviation of not more than 2% up to their critical density. The reduced pressure, π, is given as $\pi = (1 - \varepsilon')(\phi + B')\theta/\phi^2 - A'/\phi^2$, where $\varepsilon' = c'/\phi\theta^3$, $A' = A'_0(1 - a'/\phi)$, $B' = B'_0(1 - b'/\phi)$, θ = reduced temperature, ϕ = ideal reduced volume = V/V_{ci}, $V_{ci} = RT_c/p_c$ (ideal critical volume). The generalized constants, A'_0, B'_0, a', b', c' have the same numerical values irrespective of the nature of the gas. W. R. A.

536.71 : 536.423 *see Abstr.* 2864

536.71 : 536.48 2874

On some theoretical consequences of a revised equation of state and a possible explanation of liquid helium II. MACLEOD, D. B. *Trans. Faraday Soc.*, **42**, 465–8 (*June–July*, 1946).—[See Abstr. 148 (1945)]. A theoretical basis has been developed for the statement that $v_c = 2b_c$ at the critical condition. Reasons are outlined for believing that liquid helium II is due to the intermediate fluid phase, indicated by Van der Waals, becoming actual.

536.71 : 536.48 *see Abstr.* 2866

536.71 : 541.183 *see Abstr.* 2970

536.791 = 5 2875

On the thermodynamical probability of state of a mass of air. PIGNEDOLI, A. *Nuovo Cim.*, **19**, 176–81 (*May–July*, 1942) *In Italian.*—Starting from the fact that the entropy of a substance need not vanish solely at the absolute zero, but can do so over an interval (having the absolute zero as lower limit) depending on the particular substance, the author derives the thermodynamic probability of a mass of air. V. C. A. F.

ELECTRICITY . MAGNETISM . X-RAYS CHARGED PARTICLES 537/538

537.122 = 3 2876

Mass stability of electrons. BOPP, F. *Z. Naturforsch.*, **1**, 53–8 (*Feb.*, 1946) *In German.*—The development of Maxwell's field theory by Dirac and Stueckelberg is discussed and the conditions to be satisfied by such a theory are propounded with particular reference to the condition of "mass stability" which is dealt with in some detail. W. E. D.

537.122 : 530.145 *see Abstr.* 2766

537.123 : 537.591.1 *see Abstr.* 2904

537.224 : 550.37 = 3 2877

Tests on the spontaneous charging of isolated conductors. V. SCHWEIDLER, E. *S.B. Akad. Wiss. Wien*, **149**, 2*a* (*Nos.* 3–4) 133–44 (1940) *In German.*—A further attempt is made to verify experimentally Simpson's suggestion [Abstr. 870 (1904)] that the negative charge of the earth is due to a corpuscular radiation of cosmic origin. The test equipment consists essentially of two evacuated concentric cylinders, the outer of which is 20·5 cm high and 14·4 cm in diameter and the inner slightly smaller, representing a capacitance of about 70 cm. The inner cylinder is connected to an electrometer. Tests are made with the inner cylinder empty and filled with lead shot. The results obtained confirm a negative charging of the inner cylinder but as the charging does not increase proportionately with the mass the above hypothesis is not regarded as satisfactorily proved. An alternative explanation is advanced. R. H. G.

537.226 = 4 2878

Variation of dielectric polarisation with concentration. GUILLIEN, R. *Ann. Phys., Paris*, **17**, 237–64 (*March–April–May*, 1942) *In French.*—The conclusions of previous work [Abstr. 2597 (1946)] are verified for mixtures of two types of particle and a liquid. Measurements for many mixtures of liquids are included. Of recent formulae, that of Sugden is most satisfactory. A simple derivation of this is given. G. J. K.

537.226 2879

On the reaction field of an eccentric dipole. DEKKER, A. J. *Physica, 's Grav.*, **12**, 209–16 (*July*, 1946).—The Onsager–Böttcher theory [Abstr. 810 (1939)] is here extended for the case of a dipole placed eccentrically in a spherical cavity in an isotropic medium, a closer approximation to real molecules. The mean value of the reaction field is found to have the same value as before.

537.226.2 2880

Dielectric constants of the methanol-water system from 5 to 55°. ALBRIGHT, P. S., AND GOSTING, L. J. *J. Amer. Chem. Soc.*, **68**, 1061–3 (*June*, 1946).—The permittivities of the entire range of methyl alcohol-water mixtures at 10° intervals from 5 to 55° have been determined using an a.c. bridge circuit. It is claimed that the values are accurate to not less than one part in 1 000. W. R. A.

537.226.2 = 4 2881

Measurements of the permittivity of several non-polar gases (H_2, D_2, He, O_2 and air) and CO between ordinary temperatures and 20° abs. VAN ITTERBEEK, A., AND SPAEPEN, J. *Physica, 's Grav.*, **9**, 173–83 (*March*, 1943) *In French.*—Precision measurements were made using an improved version of the Verain apparatus [Abstr. 1557 (1915)], which is described. At liquid oxygen and liquid nitrogen temperatures, the polarization of CO rises as the pressure is reduced, but no change was observed with O_2. The dipole moment of CO was calculated from the results to be $0{\cdot}11\times10^{-18}$. The Clausius–Mosotti law was confirmed by measurements on H_2, D_2 and He at liquid hydrogen temperature. The polarization agrees well with the corresponding liquid, except for O_2. The second virial coefficient of D_2 was calculated from the results to be $B = -12{\cdot}2\times10^{-3}$ (for H_2, $B = -6{\cdot}42\times10^{-3}$).

537.226.2 = 4 2882

Measurements of the permittivity of gaseous CO_2 up to 10 atm. VAN ITTERBEEK, A., AND SPAEPEN, J. *Physica, 's Grav.*, **9**, 43–7 (*Jan.*, 1944) *In French.*—Using the apparatus previously described [Abstr. 2881 (1946)], the Clausius–Mosotti function at 1 atm. was found to be 7·33 and to be independent of the pressure to an accuracy of about 1/700.

537.226.2 : 534.321.9 = 4 2883

Measurements of the permittivity of CO_2, NH_3 and of mixtures. VAN ITTERBEEK, A., AND DE CLIPPELEIR, K. *Physica, 's Grav.*, **12**, 97–104 (*June*, 1946) *In French.*—The permittivity has been measured at about one atmosphere between 0°–120°C. The polarization of CO_2 has been computed taking into account the data published by Michels [Abstr. 3407 (1939), 3182–4 (1937)] on the equation of state, and is found to be independent of temperature even at high temperatures. From the measurements on NH_3 the dipole moment was calculated to be $\mu = 1\,437\cdot10^{-18}$ e.s.u. and the deformation polarization $\alpha = 6\,829\cdot10^{-24}$ cm³. In connection with ultrasonic absorption measurements previously made on CO_2 gas to which a small amount of H_2 and He had been added [Abstr. 2966 (1939), 840 (1940)], the permittivity of CO_2–H_2 and CO_2–He mixtures were also measured. As for the sound absorption measurements, an interaction was found, but much smaller for He than for H_2.

537.226.2 : 541.57 *see Abstr.* 2982

537.226.3 : 621.315.61.015.5 : 537.311.1 *see Abstr.* 2887

537.226.31 : 532.133 2884

Dielectric relaxation and viscosity of long-chain dipolar liquids. SCHALLAMACH, A. *Trans. Faraday Soc.*, **42**, 495–507 (*June–July*, 1946).—It is shown experimentally that the temperature coefficients of dielectric relaxation time and viscosity of a number of long chain liquids are not generally equal, in contradiction to the behaviour of liquids of low molecular weight. Implications of the kinetic theory are briefly discussed.

537.226.31 : 544.8 = 3 2885

Identification of dielectric mixtures by loss angle measurements. SCHUPP, P. O. *Wiss. Veröff. Siemens-Werk.*, 230–42 (1940) *Werkstoff-Sonderh. In German.*—The chemical composition of some mixtures of isomeric dielectric substances are difficult to determine accurately. It is shown by examples that, by measurement of the dielectric behaviour over a sufficient range of temperature and frequency, the individual molecules can be identified. The results lead to an extension of Debye's theory. It is suggested that a systematic development of the method would yield important physical and chemical data. A. M. T.

537.226.33 2886

The lower Curie-point of ferro-electric salts. BARKLA, H. M. *Nature, Lond.*, **158**, 340–1 (*Sept.* 7, 1946).—Experiments were made, by a static method in which a measured charge is supplied to a crystal of KH_2PO_4 to maintain a fixed potential across it as its temperature is altered. These showed that, in a constant field, the electric moment of the salt is unchanged on passing through the "lower Curie point." At the upper Curie point, the growth of spontaneous polarization could be followed, agreeing with values observed in measurement of the electric hysteresis. In the latter, Barkhausen jumps were observed to occur some seconds or even minutes after a change of field.

537.226.33 : 538.23 : 539.389.4 *see Abstr.* 2958

537.228.1 : 534.121.1 *see Abstr.* 2809

537.311.1 : 537.226.3 : 621.315.61.015.5 2887

Theoretical physics in industry. FRÖHLICH, H. *Nature, Lond.*, **158**, 332–4 (*Sept.* 7, 1946).—A short review is given of the modern theory of electrical conduction in solids divided into the following sections: free electrons in solids; theory of dielectric breakdown; theory of dielectric loss.

537.312.5 : 621.383.4 2888

Thallous sulfide photo-conductive cells. I. Experimental investigation. VON HIPPEL, A., CHESLEY, F. G., DENMARK, H. S., ULIN, P. B., AND RITTNER, E. S. *J. Chem. Phys.*, **14**, 355–69 (*June*, 1946).—The results presented include an investigation of the sensitizing oxidation reaction; cell characteristics as function of voltage, temperature, light intensity, wavelength, modulating frequency and composition; measurements of thermo-effect and optical absorption; X-ray and electron diffraction studies; and an examination of the photo-response to light flashes of very short duration.

537.312.5 : 621.383.4 2889

Thallous sulfide photo-conductive cells. II. Theoretical discussion. VON HIPPEL, A., AND RITTNER, E. S. *J. Chem. Phys.*, **14**, 370–8 (*June*, 1946).—A theory is formulated which is in substantial agreement with all facts reported in the previous paper. The underlying physical picture is that light is absorbed in the Tl_2S proper and in the presence of oxygen, positive "holes" and negative oxygen ions are formed. The "holes" and ions recombine at a rate proportional to the product of their concentrations. During their lifetime, the negative ions act as space charge compensators for the defect conduction and allow correspondingly higher currents to flow. This space charge compensating action, which is similar to the role played by positive ions in gas discharges, seems to be one essential mechanism of producing secondary photo-effects.

537.312.62 2890

The electrical conductivity of rapidly frozen solutions of sodium in liquid ammonia. BOORSE, H. A., COOK, D. B., PONTIUS, R. B., AND ZEMANSKY, M. W.; OGG, R. A. *Phys. Rev.*, **70**, 92–3 (*July* 1 *and* 15, 1946).—Negative results of attempts to repeat Ogg's demonstration of superconductivity [Abstr. 1894 (1946)] are reported. In a second note, Ogg describes the experimental conditions of his demonstration.

537.312.62 : 538.113 2891

Diamagnetism and superconductivity of a collective electron assembly. BAND, W. *Proc. Camb. Phil. Soc.*, **42**, 311–27 (*Oct.*, 1946).—A tentative theory of superconductivity is advanced on the following lines: The ideal resistance of a conductor can be neutralized by an exchange energy between electrons at sufficiently low temperatures. The surface of the conductor, and internal surfaces of discontinuity if sufficiently marked, are regarded as sites for two-dimensional resonance states in equilibrium with the three-dimensional resonance states in the metal. The superconducting transition occurs when, at the critical temperature, the neutralization of the ideal resistance of the surface by-passes the residual resistance of the body of the metal. At the same critical temperature, equilibrium conditions ensure that exactly the right number of electrons enter the surface states to give the whole metal an ideal diamagnetic susceptibility. These equilibrium conditions are disturbed by a magnetic field, and the transition temperature is shown to depend on the magnetic field in the observed manner. Other observed facts receive a qualitative explanation.

537.312.62–972 2892

Superconductivity of lead at 3-cm wave-length. BITTER, F., GARRISON, J. B., HALPEM, J., MAXWELL, E., SLATER, J. C., AND SQUIRE, C. F. *Phys. Rev.*, **70**, 97–8 (*July* 1 *and* 15, 1946).—Measurements of the Q of a Pb resonator show a large rise in the conductivity between 30°K and 4°K. Q values of the order of 5×10^6 were measured by means of specially developed stable oscillators, frequency variation being accomplished by adding or subtracting the frequency of a separate (megacycle) oscillator.

537.363 : 535.321 *see Abstr.* 2827

537.363 : 541.18 *see Abstr.* 2966, 2967

537.364 : 541.134 2893

The electrical double layer, the electrokinetic potential, and the streaming current. NEALE, S. M. *Trans. Faraday Soc.*, **42**, 473–7 (*June–July*, 1946).—Starting from the Poisson equation of electrostatics, and the Boltzmann expression for the distribution of ions in an electric field, equations are deduced which describe the structure of the ionic atmosphere of an electrically charged surface in a mono-monovalent electrolyte, and determine the potential at the surface. An expression is deduced for the quantity of electricity carried by a stream of liquid through a plug of electrically charged fibres. This expression may be used to calculate the surface potential of the fibre, and its electric charge density from the experimentally ascertainable streaming current.

537.364 : 541.134 2894

Electrokinetic measurements with textile fibres and aqueous solutions. NEALE, S. M., AND PETERS, R. H. *Trans. Faraday Soc.*, **42**, 478–87 (*June–July*, 1946).—A technique is described for the measurement of the surface potential ψ_0 of fibrous non-conductors in aqueous solutions. The variation of potential with concentration for neutral electrolytes $>0{\cdot}001$ M concentration agrees with the theoretical principles of the preceding paper. For the amphoteric fibres silk, wool and Nylon, ψ_0 is, below pH 6, a linear function of pH and changes sign at about pH 3. For the neutral fibres cotton, Vinyon and cellulose acetate ψ_0 decreases rapidly below pH 5, but there is no evidence for a reversal of charge. This is similar to the behaviour of ethyl and propyl benzene in dilute acid solutions. It could be accounted for by a drift of electrons from liquid water towards the non-aqueous phase. Such a tendency would be repressed by the presence of excess protons in the aqueous phase. The adsorption of ions with specific affinity for the fibres causes marked changes in the ψ_0 values for wool and cotton.

537.523.4 : 535.354 2895

The emission of light from spark discharges. CRAGGS, J. D., AND MEEK, J. M. *Proc. Roy. Soc. A*, **186**, 241–60 (*July* 9, 1946).—A study is made of the transitory effects occurring in spark channels, after the discharge gap has been completely bridged by a streamer. Hydrogen and argon at pressures of about 1 atm. have been observed, the main features being the light emitted during the period of current flow and the after-glow which persists when the current has fallen to a negligible value. The after-glow in H is probably only a thermal effect but in A it is also largely due to the persistence of atoms in metastable states. A new experimental method is employed (as well as the usual one of a revolving mirror camera), using a photo-electric electron multiplier tube coupled directly to a c.r.o. This allows quantitative light emission results to be obtained. For currents of about 100 A, lasting for 2–4 μsec, the after-glow in A could be detected after about 30 μsec; in H the after-glow lasted only for 3 μsec. To correlate light output with energy dissipation in the spark channel, calorimetric measurements were made from which the mean voltage drop during the passage of current was estimated. The spectra of the light emitted were also observed. The ionization density in the spark channel was found to be about 10^{17}

ions/cm³. Channel temperatures are about 10 000–15 000°K. The mechanism of the light emission is discussed. Neither normal excitation nor electron-ion recombination can be entirely responsible. L. S. G.

537.531 : 535.338.1 *see Abstr.* 2832

537.531 : 537.533.8 : 621.386.1 2896

Energy-angle distribution of betatron target radiation. SCHIFF, L. I. *Phys. Rev.*, **70**, 87–8 (*July* 1 *and* 15, 1946).—A formula is deduced for a thick target by integrating Williams' formula [Abstr. 3037 (1940)], and curves are given for 3 thicknesses of a W target. Variations of incident electron energy only affect the scale of the curves.

537.531 : 615.849.5 : 621.386.82 2897

Note on the maintenance of an X-ray dosage substandard. WEBSTER, H. C., ROBERTSON, D. F., AND STEVENS, D. J. *Brit. J. Radiol.*, **19**, 284–7 (*July*, 1946).

537.531.8 : 778.33 = 4 *see Abstr.* 3037

537.531.9 : 578.088.5 *see Abstr.* 3023, 3024

537.533.73 2898

Measurements of the relative intensity of electron diffraction patterns of copper, silver and gold. TOL, T., AND ORNSTEIN, L. S. *Physica, 's Grav.*, **7**, 685–96 (*Oct.*, 1940).

537.533.74 : 539.23 2899

The scattering of electrons by hydrocarbon films. KARLE, J. *J. Chem. Phys.*, **14**, 297–305 (*May*, 1946).—Several formulae are derived expressing the intensity of electron scattering for a variety of orientations of hydrocarbon films on a solid surface. Intensity contour maps may be constructed from these formulae for arbitrarily chosen models. These maps are helpful for determining the structure of a film and are being prepared for future publication.

537.533.8 : 621.386.1 : 537.531 *see Abstr.* 2896

537.534 : 539.172.1 2900

High energy carbon nuclei. TOBIAS, C., AND SEGRÈ, E. *Phys. Rev.*, **70**, 89 (*July* 1 *and* 15, 1946).—${}_6C^{12(6+)}$ nuclei have about the same e/m ratio as deuterons, and can be accelerated in the cyclotron to energies 6× larger. In the absence of a satisfactory ion source, only feeble beams of 96 eMV C nuclei have been obtained in the 60 in cyclotron; tracks were obtained in photographic emulsions, and specific ionization and range measured.

537.542 : 539.163.2 2901

The quantitativity of the Geiger–Müller counter. The spectrum of RaE. MILATZ, J. M. W., AND TEN KATE, H. *Physica, 's Grav.*, **7**, 779–92 (*Oct.*, 1940).—Tests were made by projecting a beam of electrons of a given velocity into the counter by means of a β-spectrograph and determining the kicks/sec as a function of the pressure of gas. In this way a "counting curve" was obtained, from which the coefficient of primary ionization could be determined. For high pressures, the number of discharges in the counter reaches a saturation-value and the indication of the counter is quantitative. It is thus possible to correct the results of a counter if it does not indicate quantitatively. The method was applied to the spectrum of RaE.

537.56 2902

On the theory of ionization yield of radiations in different substances. FANO, U. *Phys. Rev.*, **70**, 44–52 (*July* 1 *and* 15, 1946).—The energy absorbed by a substance exposed to an ionizing radiation is used partly in ionization, partly in optical excitation. Arguments based on atomic mechanics are presented, to show that the greater the ionization potential, the greater is the share of the absorbed energy which is actually spent in ionization. This explains why the ionization potential of a substance has little influence upon the amount of energy that must be absorbed by that substance per each pair of ions actually produced.

537.566 : 541.126 *see Abstr.* 2960

537.568 : 535.354 *see Abstr.* 2842

537.583 : 621.385.13.032.216 2903

Oxide coated cathode literature, 1940–1945. BLEWETT, J. P. *J. Appl. Phys.*, **17**, 643–7 (*Aug.*, 1946).—A short review of published papers, a bibliography of 30 of which is given, covering the properties of Ba; physical, electrical and thermionic properties of oxide-coated cathodes; and time effects.

537.583 : 621.385.13.032.216 : 548.73 *see Abstr.* 2999

537.591.1 : 537.123 2904

On the possible existence of negative protons in the primary component of cosmic radiation. ARLEY, N. *Physica, 's Grav.*, **12**, 177–83 (*July*, 1946).—Experimental results seem to show that both the soft and the hard component of the cosmic radiation are secondary radiations produced by primary protons. This result involves difficulties regarding the propagation in interstellar space and the latitude and east-west effect of the soft component. The hypothesis is here put forward that the primary radiation consists of negative protons as well as positive, the former being mainly annihilated at the top of the atmosphere, giving rise to the soft component, the latter ones being transformed into mesons, giving rise to the hard component. This hypothesis is shown to be compatible with all the present experimental evidence, although not with the present quantum theory which gives far too small a cross-section for the annihilation of fast negative protons. Arguments given by Heisenberg, however, predict a breakdown of the present theory for just this process.

537.591.15 = 5 2905

Experimental and theoretical determination of the density spectrum of extensive showers. COCCONI, G., LOVERDO, A., AND TONGIORGI, V. *Nuovo Cim.*, **3**, 50–6 (*Feb.*, 1946) *In Italian.*—The density spectrum of extensive showers has been deduced, recording triple and quadruple coincidences produced by extensive showers in air in groups of counters with various surfaces, at 120 and 2 200 m above sea level. The evolution mechanism of such showers is interpreted by the cascade theory and the density spectra calculated by Heisenberg and Molière's formulae. Good agreement between experimental and theoretical results suggests that the extensive showers are due to cascade-multiplication of very great energy primaries. The recorded showers indicate the existence of particles with energies up to 10^{15}—10^{16} eV.

537.591.5 = 5 2906

The barometric effect of extensive cosmic-ray showers. PATANÈ, S. *Nuovo Cim.*, **19**, 169–75 (*May–July*, 1942) *In Italian.*—The barometric coefficient of large showers with diameters of 2·5 m and 5 m was

determined, showing that: (1) In spite of different experimental conditions, the values agree well with those of other authors. (2) The barometric coefficient of the showers is the same with either pressure or altitude variation. (3) There is no increase in barometric coefficient in passing from the 2·5 m to the 5 m dia. showers. (4) The barometric coefficient remains constant with showers above 12 m in dia.

537.591.8 2907

Maxima of secondary radiation in lead by the penetrating part of cosmic rays. CLAY, J., VENEMA, A., AND JONKER, K. H. J. *Physica, 's Grav.*, **7**, 673–84 (*Oct.*, 1940).

538.082.102 : 621.317.443 2908

An electrodynamic balance for the measurement of magnetic susceptibilities. HUTCHISON, T. S., AND REEKIE, J. *J. Sci. Instrum.*, **23**, 209–11 (*Sept.*, 1946).—An electrodynamic balance of small size, designed specifically for measurement of the forces exerted on para- or diamagnetic bodies in a magnetic field, is described. The forces are compensated by passing known currents through a coil system consisting of a single fixed coil and a double coil attached to the balance arm; the latter is attached to, and supported by, a taut phosphor-bronze strip. The balance is directly calibrated with known weights, and can measure forces as low as a few hundredths of a dyne with an accuracy of about ¼%. To illustrate the working of the balance measurements of the magnetic susceptibility of pure Al at 90°K and at room temperature, using the Gouy method, are given.

538.113 : 537.312.62 *see Abstr.* 2891

538.122 : 621.3.013 2909

The unit-pole definition of magnetic field strength. HOWE, G. W. O. *Wireless Engr*, **23**, 207–10 (*Aug.*, 1946).—The electric field E and the magnetic induction B are measurable quantities. The electric displacement D and the magnetic field H are not. The author considers the determination of H for a permeable medium by what is effectively a cavity experiment. V. C. A. F.

538.221 = 3 2910

Determination of magnetic permeability from resistance measurements on iron wires of various structures at frequencies of the order of 10^8 hertz in connection with the size of the Weiss domains. STRUTT, M. J. O., AND KNOL, K. S. *Physica, 's Grav.*, **7**, 635–51 (*July*, 1940) *In German.*—The permeability of Fe wires at very high frequencies may be determined from the ratio of a.c. to d.c. resistance under certain specified assumptions. Measurements of this ratio are given for frequencies up to about 3×10^8 c/s. Whereas the permeability, calculated from the above ratio, remains practically constant up to the said frequency at room temperature, it shows a marked decrease with increasing frequency in liquid oxygen for all the measured wires. These results and hypotheses for their explanation are discussed. Experiments on very thin Fe layers upon constantan and Fe wires are described. A satisfactory explanation of the phenomena is possible with a simple model, which enables the order of magnitude of the Weiss elementary domains to be determined for the different wires. The results are compared with experiments of other authors and some unexplained questions are discussed. A bibliography of 48 entries is included.

538.222 2911

Paramagnetic absorption and dispersion in chromium potassium alum. GORTER, C. J., DIJKSTRA, L. J., AND GROENDIJK, H. *Physica, 's Grav.*, **7**, 625–34 (*July*, 1940).

538.222 = 4 2912

Law of magnetization in an S state. Paramagnetic rotatory power of gadolinium ethyl sulphate hydrate in the direction of the optic axis. BECQUEREL, J., AND VAN DEN HANDEL, J. *Commun. K. Onnes Lab., Leiden* (*No. 259d*). *Physica, 's Grav.*, **7**, 711–20 (*Oct.*, 1940) *In French.*—The continuation of previous work [Abstr. 4073 (1938)]. There is a small paramagnetic rotation which can be represented by a Brillouin function [Abstr. 2824 (1927)]. Systematic departures from the Langevin function are found.

538.224 2913

The defect in the magnetic susceptibility of manganese dioxide and other compounds of manganese. GREY, J. T., JR. *J. Amer. Chem. Soc.*, **68**, 605–8 (*April*, 1946).—The mass susceptibility of MnO_2 was measured to be $39\cdot0\times10^{-6}$ at 30°. Other compounds measured are K dioxalato-dihydroxomanganeate, K hexafluomanganeate, K dimalonato-diaquomanganiate, K pentafluo-aquo-manganiate, and K hexafluocobaltiate. The susceptibilities of the α- and β-allotropes of MnS have been confirmed. A possible theoretical explanation of the defect in susceptibility of certain Mn compounds is advanced. W. R. A.

538.23 : 537.226.33 : 539.389.4 *see Abstr.* 2958

538.24 : 536.48 2914

Experiments on adiabatic demagnetization. CASIMIR, H. B. G., DE KLERK, D., AND POLDER, D. *Commun. K. Onnes. Lab., Leiden* (*No. 261a*). *Physica, 's Grav.*, **7**, 737–46 (*Oct.*, 1940).—It is found that the temperatures calculated from the magnetic susceptibilities of three different paramagnetic salts are in agreement with the temperature scale of Bleaney and Simon [Abstr. 4108 (1939)]. The Stark splitting of $KCr(SO_4)_2 \cdot 12H_2O$ derived from the demagnetization experiments is $\delta = 0\cdot263$ degrees, that of $Cr(NO_3)_3 \cdot 9H_2O$ $\delta = 0\cdot283$. For the latter substance there is good agreement between the experiments and the formulae of Hebb and Purcell [Abstr. 2708 (1937)]. The specific heat of $K_2Cu(SO_4)_2 \cdot 6H_2O$ does not obey a $1/T^2$ law and is much higher than might be expected from magnetic interaction only. Data on the ferromagnetism of some paramagnetic salts are given.

538.244.2 2915

Strong magnetic fields. DE HAAS, W. J., AND WESTERDIJK, J. B. *Nature, Lond.*, **158**, 271–2 (*Aug.* 24, 1946).—Magnetic fields of about 250 000 gauss have been produced for periods of 0·1 sec in a cylindrical space 8 mm in diameter, by attaching a small copper coil immersed in liquid hydrogen to a very big battery. The large heat of vaporization of hydrogen is able to dissipate the relatively small amount of energy generated in the electrical resistance of the coil.

538.245 2916

On the effective length of a small Barkhausen discontinuity. SNOEK, J. L. *Physica, 's Grav.*, **7**, 609–24

(*July*, 1940).—The effective length is calculated for a wire of rectangular section to be the product of the reversible permeability μ and the thickness α_0.

538.54 = 4 2917

Simple relation between the energies dissipated by hysteresis and by eddy currents in a solid of revolution. RIBAUD, G. *C.R. Acad. Sci., Paris*, **222**, 788–9 (*April* 1, 1946) *In French.*—An h.f. field acts along the axis of revolution of a ferromagnetic body, the frequency being such that the skin thickness is small compared with the dimensions of the body. For weak fields, the ratio of the energy dissipated in hysteresis to that produced by eddy currents, is independent of the shape of the body and is equal to the area/π of the BH cycle for $H = 1$. [See Abstr. 2140 (1946)].

538.56 2918

A method of solution of field problems by means of overlapping regions. PORITSKY, H., AND BLEWETT, M. H. *Quart. Appl. Math.*, **3**, 336–47 (*Jan.*, 1946).—The field may often be found in a region which it is difficult to handle directly by dividing the region into 2 or more overlapping regions for each of which the field may be found by standard methods. The method is illustrated by the detailed analysis of the propagation of an electromagnetic wave around the corner of a rectangular wave-guide. An alternative method is briefly discussed and a comparison of the two methods is made. L. S. G.

538.56 = 4 2919

Rigorous calculation of the radiation from a linear sinusoidal oscillator. DURAND, E. *C.R. Acad. Sci., Paris*, **222**, 68–70 (*Jan.* 2, 1946) *In French.*—A unit electric charge oscillates on a line with a frequency ω. The vector and scalar potentials of the field of radiation are calculated, in terms of Bessel functions, and it is shown that in the field all the harmonics of the frequency ω appear. L. S. G.

538.565 : 621.396.611.4 = 4 2920

Characteristic oscillations of solid conductors and electromagnetic resonators. NICOLAS, P. *Ann. Radioélectricité*, **1**, 181–90 (*Jan.*, 1946) *In French.*—Maxwell's equations are written in integral form, and this form is used to demonstrate the existence and to deduce some properties of the characteristic oscillations. The method for solving the equations is indicated in a general way and the resonant frequencies appear as the roots of a certain determinantal equation. L. S. G.

538.632 = 5 2921

On the sign of the Hall effect. CARRELLI, A. *Nuovo Cim.*, **3**, 40–9 (*Feb.*, 1946) *In Italian.*—A review of the modern interpretation of the Hall effect and its application to Bi. The values of the constants obtained for Bi–Sb alloys are examined and their significance is discussed in the light of recent knowledge.

538.632 : 536.48 2922

Measurements on the Hall-phenomenon in pure bismuth single-crystals at low temperatures. GERRITSEN, A. N., AND DE HAAS, W. J. *Commun. K. Onnes Lab., Leiden* (*No.* 261*b*). *Physica, 's Grav.*, **7**, 802–16 (*Oct.*, 1940).—Crystals of varying purity and of two different orientations have been measured at a number of temperatures from 300°K to 14°K. There exists a critical purity for a maximal Hall effect, purer material shows a lower Hall tension. A Hall constant does not exist, the Hall coefficient is a complicated function of temperature and magnetic field. For the purest crystals a remarkable parallelism between Hall effect and magnetic susceptibility at hydrogen temperatures is pointed out.

538.653.1 2923

Magnetization and stress. BOZORTH, R. M. *Bell Lab. Rec.*, **24**, 116–19 (*March*, 1946).—The effect of stress in altering the magnetic properties of materials is often objectionable but finds useful application in supersonic equipment and other magnetostriction devices. Permeability of some substances increases with tension, notably 68 permalloy; in others, such as Ni, it decreases, whereas in Fe permeability increases with tension in low fields and decreases in higher ones. These variations are discussed and results shown for 68 permalloy, Ni and annealed iron. M.-V.

538.691 2924

Apparatus for illustrating the trajectory of an electrified particle in a magnetic field. LOEB, J. *C.R. Acad. Sci., Paris*, **222**, 488–90 (*Feb.* 25, 1946) *In French.*—If a wire, whose weight and radius can be neglected, carries d.c. and is situated in a plane normal to a magnetic field, it will take the shape of the trajectory of an electrified particle in the same magnetic field if $T/I = mv/e$, where T is the tractive force on the wire, I the current and m, v and e the mass, velocity and charge of the moving particle. Experiments with a silver wire of 0·02 mm dia. and carrying a current of 500 mA verified this relation. With a tension of 18 dynes the curvature of the wire corresponds to that of the path of a 10 kV electron in the same field. The method can be extended to extreme cases by application of the principle of similitude and can be particularly useful for studying the motion of electrified particles in the earth's magnetic field and in magnetic electron lenses. A. W.

538.74 2925

Magnetostriction compass. ROWE, R. G. *Electronics*, **18**, 123–5 (*July*, 1945).—Two rods of annealed steel are initially positioned in an E.–W. direction, slightly magnetized, in opposing senses, from a d.c. source and vibrated at their resonant frequency by an a.c. supply. Crystal pick-ups at the ends of the rods detect the vibrations and feed a centre-zero galvanometer through two balanced amplifiers. Rotation of the rods alters the earth's magnetic flux in them, which by the magnetostriction effect changes their length and their resonant frequency, altering the amplitude of vibration and unbalancing the galvanometer which then indicates the change of direction. E. D. H.

RADIOACTIVITY . MOLECULES . ATOMS 539

539.13 : 541.57 *see Abstr.* 2983, 2984, 2985

539.132 2926

A relation between internuclear distances and potential barriers of methyl groups. FRENCH, F. A., AND RASMUSSEN, R. S. *J. Chem. Phys.*, **14**, 389–94 (*June*, 1946).

539.132 2927

The determination of dissociation energies by the Birge–Sponer extrapolation. GAYDON, A. G. *Proc. Phys. Soc., Lond.*, **58**, 525–38 (*Sept.*, 1946).—A critical examination is made of the Birge–Sponer method of determining dissociation energies of diatomic molecules [Abstr. 48 (1927)]. Values determined by linear extrapolation are compared with those determined independently. For the ground states of ordinary molecules the linear extrapolation tends to give too high results, often by around 20%. For molecules in which ionic binding is important the extrapolation often comes too low, sometimes much too low. For the molecules in which one atom has a $^1S_0$ ground state the linear extrapolation is much too high. The method appears to work satisfactorily for ionized molecules. Excited states of molecules cannot, in general, be relied on to give good extrapolations. These empirical observations are discussed in terms of the potential-energy curves and the binding forces in the molecules at large inter-nuclear distances.

539.133 : 532.13 *see Abstr.* 2784

539.133 : 533.15 *see Abstr.* 2805

539.133 : 535.338.4–31 *see Abstr.* 2834

539.133 : 535.343.4–15 2928

Notes on the infra-red spectrum and molecular structure of ozone. ADEL, A., AND DENNISON, D. M. *J. Chem. Phys.*, **14**, 379–82 (*June*, 1946).—The nature of the fine structure of the band at 14·2 μ in the absorption spectrum has been determined. These data, together with the finest ructure of the 9·57 μ band (previously resolved in the solar spectrum) render possible an unambiguous choice between divergent views of structure of the ozone molecule. It is concluded that the form of the isosceles triangle is acute, with the apex angle in the neighbourhood of 34°.

539.152.1 = 4 2929

Influence of "Schwinger" forces on nuclear processes. MARTINS, J. L. R. *Portugaliae Physica*, **2** (*No.* 1) 99–119 (1946) *In French.*—Experimental determination by Kellog, Rabi, Ramsay and Zacharias of the quadrupole moment of the deuteron indicates that the normal state is a mixture of $^3S_1$ and $^3D_1$. This conclusion seems to be inconsistent with some results of Beck and Tsien on the resonance scattering of protons. In an attempt to reconcile these results, the present investigation of "Schwinger" forces has been pursued. It is found that such forces lead, in certain circumstances, to a high probability of reversal of spins even when these forces are weak compared with the binding forces of the nucleus. W. E. D.

539.152.1 2930

Resonance reactions and anomalous scattering. WIGNER, E. P. *Phys. Rev.*, **70**, 15–33 (*July* 1 *and* 15, 1946).—The purpose of the paper is to give a derivation of the resonance formula for nuclear reactions which is free from artificial assumptions. The wave function with respect to the energy is developed as a Taylor series, and it is assumed that the first (energy independent) term is the same, within a region where all particles are close together, however the compound state is formed. The second term can be calculated easily, and is done for resonance scattering and resonance reactions, assuming zero orbital angular momentum round the centre of mass of the colliding particles. The third term is shown to be negligible over a very wide energy range for resonance scattering if there are no other resonances near. More general scattering cross-section formulae are obtained, containing terms interpretable as potential scattering and reaction. The case of orbital angular momentum h is discussed, and it is shown that the region of validity of the formulae extends to the neighbouring resonances.

539.152.2 2931

The magnetic moments of H^3 and He^3. SACHS, R. G., AND SCHWINGER, J. *Phys. Rev.*, **70**, 41–3 (*July* 1 *and* 15, 1946).—A measurement of the magnetic moments of the nuclei H^3 and He^3 would yield information concerning the deviations from *L–S* coupling in these nuclei. It is shown that the sum of the moments of the two nuclei can be directly related to the amount of admixture of the ^2P, ^4P and ^4D eigenfunctions with the ^2S function. Thus the measurement of both moments would lead to direct information concerning the contributions of these functions to the ground state of the two nuclei. The individual moments depend to some extent on the detailed properties of the wave functions, but if only the ^2S and ^4D functions contribute appreciably to the ground state, and if particularly simple forms of these functions are assumed, the moment of each nucleus is shown to be expressible in terms of the amount of admixture of the two functions. If then the amount of ^4D function is taken to be 4%, the moments of H^3 and He^3 are found to be 2·71 and −1·86 nuclear magnetrons, respectively.

539.155.2 = 3 2932

A new Mattauch–Herzog double focussing mass spectrograph. The masses of C^{13} and N^{15}. EWALD, H. *Z. Naturforsch.*, **1**, 131–6 (*March*, 1946) *In German.*—Construction details are given of a mass spectrograph which aims at combining mechanical rigidity with accuracy and ease of adjustment. The apparatus is then used for measuring the $C^{12}H$–C^{13} and $C^{12}H_3$–N^{15} doublets leading to the values 13·007581 ± 0·000025 m.u. and 15·004934 ± 0·000030 m.u. for the masses of C^{13} and N^{15} respectively. W. E. D.

539.155.2 2933

Particle accelerators as mass analyzers. WEISZ, P. B. *Phys. Rev.*, **70**, 91 (*July* 1 *and* 15, 1946).—A type of linear accelerator is proposed, in which a pulsed beam of mixed ions receives an initial acceleration, subsequent accelerations being so phased that ions of a particular mass receive no further increase of energy. An example is given which shows that 4 steps of 1 ekV acceleration would give an energy ratio of 2 : 1 to ions differing in mass by 2%. "Harmonic masses" could be distinguished by their different times of arrival.

539.155.2 : 533.15 = 3 *see Abstr.* 2804

539.155.2 : 541.135 2934

Efficiency of the electrolytic separation of potassium isotopes. HUTCHISON, D. A. *J. Chem. Phys.*, **14**, 401–8 (*July*, 1946).—The electrolytic separation coefficient, α, has been determined for the K isotope separation in the electrolysis of aqueous solutions of KCl at a flowing Hg cathode. Suspension of purified

KCl crystals in a liquid mixture of bromoform, *n*-pentanol, and *n*-hexanol served as the analytical procedure in determining the isotopic composition of samples. Densities of the liquid suspension mixture as a function of temperature were independently determined. α was found to be $1{\cdot}0054 \pm 0{\cdot}0005$ for the temperature range of 15°–50°C, and, within the limits of error, was independent of temperature, of the fraction electrolysed, of the concentration of the electrolytic solution, of the current density, and of the amount of back reaction at the cathode. An empirical relation between the electrolytic separation factors of elements thus far investigated and their atomic weights is presented.

539.156 : 535.342 = 4 2935

Study of energy transfer in atomic collisions. DUPUY, M. *Ann. Phys., Paris*, **20**, 178–227 (*March–April*, 1945) *In French.*—Anomalies in absorption and fluorescent spectra of monatomic vapours (Na, Cd and Th) were investigated, using high intensity sources. Earlier experimental evidence is reviewed in detail, and results on multiple absorption, association to form molecules, and the effects of pressure, as well as the part played by added gases in suppressing fluorescence, are used to show the difficulties of reliable interpretation of the evidence. The theory of internal and translational energy transfer is discussed, and experimental verification given. For use in deciding suitable concentrations, the mean life of the sodium 3^2P state is calculated. G. J. K.

539.16.08 : 771.531.1–834 2936

New photographic emulsions showing improved tracks of ionizing particles. DEMERS, P. *Phys. Rev.*, **70**, 86 (*July* 1 *and* 15, 1946).—The procedure is described for the preparation of dense emulsions containing as high as 95% of AgBr in small grains. Tracks of fission particles, α-rays and protons are recorded, and the properties of the emulsion can be adjusted to bring out one or other of these. For proton tracks, each developed grain corresponds to an energy loss of 5 ekV.

539.163.2 2937

The probability of excitation of the nucleus ^{206}Pb in the α-disintegration of polonium. FEATHER, N. *Phys. Rev.*, **70**, 88–9 (*July* 1 *and* 15, 1946).—Chang's allocations [Abstr. 1948 (1945)] are criticized on the grounds of incompatibility with the intensities of the γ-ray spectra of excited Pb^{206} as measured by Bothe [Abstr. 4536 (1935), 2931 (1936)] and Webster [Abstr. 3803 (1932)]. If Chang's intensity measurements of Po α-ray fine structure are correct, some entirely new effect is in question.

539.163.2 : 537.542 *see Abstr.* 2901

539.163.4 : 542.3 *see Abstr.* 2988

539.164.75 2938

The straggling of Po α-particles in solid matters. RUTGERS, G. A. W., BLOEMBERGEN, N., AND KLUYVER, J. *Physica, 's Grav.*, **7**, 669–73 (*Oct.*, 1940).—The straggling parameter of the ranges was determined for Al, Ni, Ag, Au and mica. For the elements with a high atomic number, the measured values are not in accordance with theory.

539.164.93 : 778.34 : 549.12 2939

The localization of uranium and thorium minerals in polished section. YAGODA, H. *Miner. Soc. Amer. J.*, **31**, 87–124 (*March–April*, 1946).—A selective α-ray emission pattern on light-desensitized emulsions provides a means of identification and localization of U and Th minerals in polished sections. The radioactive minerals can be divided into 7 groups as a preliminary towards their identification by the relative intensity of the image. The emulsion has been studied intensively with respect to its behaviour towards radiation, and a developing procedure is described which, it is claimed, will produce a sharply defined autoradiographic image of reproducible density. The latent image fades if development is delayed, and Hg vapour completely destroys the image. M.-V.

539.167.3 = 3 2940

Isomers of the stable nuclei rhodium and silver. FLAMMERSFELD, A. *Z. Naturforsch.*, **1**, 3–10 (*Jan.*, 1946) *In German.*—Rh and Ag are bombarded with D + D neutrons. A new active Rh is found with a half-life of 48 min and is attributed to an excited state of Rh^{103}, being formed by the process $Rh^{103}(n, n)\,Rh^{103*}$. Reasons are given for attributing to it a nuclear spin of $\frac{1}{2}$. In the case of Ag some earlier discrepancies are cleared up. Neutron bombardment produces three activities: 24 sec, 40 sec and 2·4 min. The 24 sec and 2·4 min only appear when a "thick" Ag foil is used, while only the 40 sec and 2·4 min when a very thin foil is used in conjunction with a very thin-walled counter. The explanation offered is that the 40 sec activity is associated with a very soft radiation, which is verified by direct absorption measurements; this activity is attributed to an excited state of one of the isotopes $Ag^{107, 109}$. This is in agreement with previous work of Alvarez, Helmholz and Nelson [*Phys. Rev.*, **57**, 660 (1940)] in which a 40 sec activity was found, produced by the β-decay of Cd and attributed to $Ag^{107, 109}$. W. E. D.

539.167.3 2941

Preparation of high specific induced radioactivity by neutron bombardment of metal chelate compounds. DUFFIELD, R. B., AND CALVIN, M. *J. Amer. Chem. Soc.*, **68**, 1129 (*June*, 1946).—Neutron bombardment of Cu salicylaldehyde-*o*-phenylenediimine led to a concentration of 12·8 hr. Cu^{64}, and, although the method has no practical value for the production of this isotope, the general method is expected to be useful as a method for enriching the isotopic content of the metal in chelate compounds of other metals. W. R. A.

539.167.3 2942

Assignment of mass to 46-hr samarium and 9·2-hr europium by a mass spectrograph. HAYDEN, R. J., AND INGHRAM, M. G. *Phys. Rev.*, **70**, 89 (*July* 1 *and* 15, 1946).—A Sm preparation irradiated with neutrons was analysed in a mass spectrograph, the resulting photographic plate showing the normal Sm mass spectrum. This plate was then placed face to face with another plate, which on later development showed only lines corresponding to the Sm^{153} and $Sm^{153}O^{16}$ lines of the mass spectrum. Measurements of decay characteristics confirmed that the half-life was 46 hr. Similarly, Eu^{152} was found responsible for the 9·2 hr activity.

539.172.1 : 537.534 *see Abstr.* 2900

539.172.4 2943

Fission fragment tracks in photographic plates. GREEN, L. L., AND LIVESEY, D. L. *Nature, Lond.*, **158**, 272 (*Aug.* 24, 1946).

539.18 : 530.145.6 = 5 *see Abstr.* 2768

539.185 = 5 2944

The albedo of slow neutrons. AGENO, M. *Nuovo Cim.*, **3**, 3–14 (*Feb.*, 1946) *In Italian.*—Arley has shown [*Kgl. Dansk. Vid. Selsk. Medd.*, **16**, 1 (1938)] that the scattering process of slow neutrons in paraffin can be represented by a scattering probability in the solid angle $\sin\theta d\theta d\phi$ of $d\phi(1 + a\cos\theta)\sin\theta d\theta/4\pi$, where θ is the angle between neutron velocities after the collision, and $a \sim 0{\cdot}4$. The purpose of this work is to see how the expression $\alpha = \rho(\infty)/\rho(0) = 1 + \sqrt{(N+1)}$ for the ratio of neutron densities on the border and inside a paraffin half-space must be changed to take into account Arley's results. N is the ratio of scattering and absorption cross-sections and α is connected with the albedo β by the expression $\alpha = 2/(1-\beta)$. The diffusion equation (unidimensional) is solved by an approximation method used by Wick in the case $a = 0$, which consists in substituting it with a set of linear differential equations. The ratio α is calculated by introducing convenient polynomials. A figure is given where N is plotted as a function of a for different values of α. From the graph and cross-section measurements one would expect a value of $\alpha \sim 13{\cdot}5$. Experimental data are not accurate enough to confirm Arley's result.

539.185 = 5 2945

Diffraction effects in the scattering of fast neutrons. AMALDI, E., BOCCIARELLI, D., CACCIAPUOTI, B. N., AND TRABACCHI, G. C. *Nuovo Cim.*, **3**, 15–21 (*Feb.*, 1946) *In Italian.*—Neutrons of the D + Li reaction detected by means of the $Cu^{63}(n, 2n)Cu^{62}$ process, extend over a rather narrow energy interval with mean ~ 14 eMV; their de Broglie wavelength is $7{\cdot}5 \times 10^{-13}$ cm, so that they appear very convenient for investigation of possible diffraction effects in elastic scattering by medium and heavy nuclei. Using these neutrons, three experiments were carried out: (1) for 19 elements the total cross-section was measured, i.e. the cross-section for formation of the compound nucleus + the cross-section for elastic scattering; (2) for 4 elements the cross-section for inelastic scattering + absorption was measured; this is almost equal to the cross-section for formation of the compound nucleus. The values $\simeq \frac{1}{2}$ the preceding ones; the large difference is due to elastic scattering which can be further investigated by measuring the angular distribution of scattered neutrons; (3) finally, the authors measured the angular distribution of the neutrons scattered by Pb, using a disposition with good angular definition. The differential cross-section has the typical shape of a diffraction curve which shows, besides a very strong maximum in the forward direction, a second small maximum at about 40°. From such a curve the dimensions of the Pb nucleus are deduced using the formula for Fraunhofer diffraction around a spherical obstacle.

539.185 2946

The slowing down of low energy neutrons in water. II. Determination of photo-neutron energies. O'NEAL, R. D. *Phys. Rev.*, **70**, 1–4 (*July* 1 *and* 15, 1946).—A new method for determining neutron energies which should be particularly useful below 500 ekV has been developed and applied. The method consists in slowing down the neutrons from the source in water and measuring the distribution of D group neutrons. The arrangement is calibrated with neutron sources of known energy. The energies of the photo-neutrons emitted from Y(100*d*) + Be and Sb(60*d*) + Be have been determined and found to be 220 ± 20 ekV and 100 ± 20 ekV respectively. This is in agreement with previous measurements by other methods. This method has the advantage of great simplicity and should be applicable to neutron energies below 100 ekV, which cannot be studied by other known methods.

539.185 2947

High energy neutron-proton scattering and the meson theory of nuclear forces with strong coupling. LOPES, J. L. *Phys. Rev.*, **70**, 5–15 (*July* 1 *and* 15, 1946).—In the first part of this paper the anisotropy of the elastic scattering of 14 eMV neutrons by protons is investigated in the meson field theory of nuclear forces with the scheme proposed by Møller and Rosenfeld [see Abstr. 2594 (1946)] in the strong coupling limit and in the symmetrical form. In the second Born's approximation, the virtual isobars decrease the ratio R of the differential cross sections in the backward and perpendicular directions (in the centre of mass system), and R decreases with the isobar energy. R is still >1; nevertheless, the results suggest the possibility that the combined effects of the virtual isobars and the tensor force might give a forward scattering in agreement with Amaldi's experiments. In the second part, the cross section of the inelastic scattering of 100–200 eMV neutrons by protons with production of isobars is evaluated in the Møller–Rosenfeld, pseudoscalar and Schwinger theories. The ratio of the total inelastic cross section and the elastic one $\simeq 0{\cdot}03$, for 100 eMV neutrons and for an isobar energy equal to 45 eMV. An experiment to detect the isobars would be important for a check of the fundamental ideas of the strong coupling formalism.

539.185.7 2948

Capture cross sections for slow neutrons. II. Small capture cross sections. MUEHLHAUSE, C. O., AND GOLDHABER, M. *Phys. Rev.*, **70**, 85 (*July* 1 *and* 15, 1946).—Correction for scattering has to be made when measuring capture cross-section with the method described in Abstr. 2159 (1946). This becomes serious when measuring small capture cross-sections (Be, Si, Bi) and alterations of the geometry have been made which greatly reduced the scattering correction. Some results for these elements are quoted, but the capture cross-sections are so low ($<10^{-26}$ cm^2) that the actual values are unreliable.

STRUCTURE OF SOLIDS 539.2

539.215 : 548.735.7 *see Abstr.* 3006

539.216 2949

Collapse of capillaries in the drying of porous gels. BANKS, W. H., AND BARKAS, W. W. *Nature, Lond.*, **158**, 341–2 (*Sept.* 7, 1946).—A capillary losing liquid

by evaporation at a particular vapour pressure will undergo a hydrostatic tension which may reduce it in size. This will delay evaporation until a lower vapour pressure is reached, by which time the tension has further increased. An unstable state may be reached where the capillary wall cannot resist the rise in tension, and collapse will result. An example is worked out mathematically, and examples found in the drying of wood are pointed out.

539.216 : 539.388.8 = 3 2950

Relationship between the moisture content of fibrous materials and the relative atmospheric humidity in absorption and desorption. Hysteresis of swelling. KOCH, H. *Schweiz. Arch. angew. Wiss. Tech.*, **12**, 176–84 (*June*, 1946) *In German.*—A formula based on the method of least squares is deduced, giving the approx. relationship between the R.H. (25–98%) and moisture content of fibrous materials (crude and bleached cotton, rayons) and casein powder, in presence of atmospheric moisture at 16–18°, calculated values. The accuracy over this range is sufficient for most technical purposes. In a modified formula, a term is introduced to allow for the effects of capillary attraction, and Müller's method is used to correct for temperature effects. Results are also tabulated for hydro-cellulose and pure cellulose (filter paper), and comparison is made with those obtained by Schaposchnikow for crude cotton. The S-shape of the moisture-humidity curve is characteristic for all vegetable and animal fibres. A method for determining the point of inflexion of such curves is given; the max. hysteresis value may then be measured by the difference between the moisture contents of the fibre at these points on the absorption and desorption curves. J. G.

539.217.3 : 621.315.616.1 : 678.1 = 3 2951

Water absorption of industrial rubber. VEITH, H. *Wiss. Veröff. Siemens-Werk.*, 318–33 (1940) *Werkstoff-Sonderh. In German.*—Existing data on the water absorption of rubber, as used in the cable industry and for general electrical purposes, is reviewed and extended by certain measurements. The extremely long time for saturation to be attained is noteworthy; it may be 10 years or more in 100% R.H. The facts are considered from a thermodynamic point of view, and on this basis an explanation is given of the connection between the absorption and the special elastic properties of rubber, and the relationship to osmotic phenomena. The influence of water diffusion by absorbing materials and the applicability of Fick's law is discussed. Some conclusions with regard to the behaviour of rubber as an industrial insulating material and the possibility of obtaining a lower water absorption are given. A. M. T.

539.23 : 537.533.74 *see Abstr.* 2899

539.232 2952

Oxide films formed on metals and alloys at moderate temperatures. PHELPS, R. T., GULBRANSEN, E. A., AND HICKMAN, J. W. *Industr. Engng Chem.* (*Analyt. Edit.*) **18**, 391–400 (*June*, 1946).—A study of the oxidation process occurring on metals is reviewed. The work was carried out by electron diffraction and electron microscopy methods. The oxide films were stripped by means of an electrolytic apparatus. The apparatus and techniques employed are briefly described. Metals studied include Cr, Co, Cu, Fe, Mo, Ni, Al, Cb and W. Results of the study, in the form of electron micrographs, electron diffraction patterns and tables, are discussed; it is shown that the oxide films consist of small oxide crystals ranging in size from 100 to 2 500 Å. M.-V.

ELASTICITY . STRENGTH . RHEOLOGY 539.3/.8

539.31 = 4 2953

Theory of elastic forces. DE BEAUREGARD, O. C. *C.R. Acad. Sci., Paris*, **222**, 477–9 (*Feb.* 25, 1946) *In French.*—The author applies his definition of covariant force [*C.R. Acad. Sci., Paris*, **221**, 473 (1945)] to the forces in the body of a fluid, produced by a force-field at the boundary of the fluid. The proper-mass of a drop of fluid is not conserved under these conditions. G. C. McV.

539.313 2954

Finite strain in aelotropic elastic bodies. II. SETH, B. R. *Bull. Calcutta Math. Soc.*, **38**, 39–44 (*March*, 1946).—Previous work [Abstr. 844 (1946)] is extended and these problems are solved: (1) Torsion of a circular cylinder; (2) a spherical shell under uniform normal traction; (3) a cylindrical shell under uniform normal traction. L. S. G.

539.313 : 591.112 *see Abstr.* 3025

539.374 2955

The theory of plasticity—an outline of work done in Russia. SOKOLOVSKY, W. W. *J. Appl. Mech.*, **13**, *A*1–10 (*March*, 1946).—A summary of an address given in Moscow in June, 1945. Equations expressing the state of strain beyond the elastic limit have been given by several authors. Expressions have been obtained for the components of deformation expressed through the stress components; and the inverse expressions have been given both in the case of ideal plasticity (Mises condition) and in the case of strain-hardening according to the Schmidt condition. A new theory of viscous materials has been evolved which, in addition to the Saint-Venant hypothesis, assumes that the maximum shearing stress in flow is always greater than a certain constant and depends linearly on the maximum rate of shear. The theory of stability beyond the elastic limit has also been developed. The elastico-plastic bending of shells and plates and the plastic states of plane strain have received a good deal of attention. A bibliography of relevant Russian literature is appended. L. S. G.

539.374 2956

The effect of hydrostatic pressure on plastic flow under shearing stress. BRIDGMAN, P. W. *J. Appl. Phys.*, **17**, 692–8 (*Aug.*, 1946).—This paper presents measurements of the forces required to drive a punch into plates of several grades of steel as a function of the distance of penetration, the operation being conducted in a fluid medium subjected to hydrostatic pressures up to 30 000 kg/cm². Qualitatively, the effects are similar to those already found for the tensile properties [Abstr. 568 (1946)], namely, ductility is greatly increased, and greatly increased distortion is tolerated without fracture. At $\geqslant$20 000 kg/cm² a punch may be driven completely through a plate of mild steel, with no loss of coherence at any stage of

the process, and with strain hardening, when expressed in terms of true shearing stress, which may increase by a factor of as much as 3. If the punching operation is suspended at any intermediate stage before complete penetration and afterward completed at atmospheric pressure, very material strengthening is found as compared to virgin material of the same geometrical configuration.

539.388.23 : 548.736 *see Abstr.* 3007

539.388.8 : 536.7 : 541.182.5 *see Abstr.* 2968

539.388.8 : 539.216 = 3 *see Abstr.* 2950

539.389.4 2957

Hysteresis and related elastic properties of tire cords. WAKEHAM, H., AND HONOLD, E. *J. Appl. Phys.*, **17**, 698–711 (*Aug.*, 1946).—A method of evaluating mechanical hysteresis, elastic modulus, elongation and growth rate of a yarn or cord subjected to cyclic loads in a fatigue test is described. The test is applied to seven typical tyre cords. Results are presented showing the effect of cycle number, moisture content, temperature, and load range on the elastic properties of each of the cords tested. The influence of cyclic loading on the stress-strain curve is also discussed. It is concluded that moisture content is the dominant factor influencing the elastic properties and that the heat produced by mechanical hysteresis of the cord contributes appreciably to the heat build-up observed in tyres during heavy duty service.

539.389.4 : 537.226.33 : 538.23 2958

Several after-effect phenomena and related losses in alternating fields. SNOEK, J. L., AND DU PRÉ, F. K. *Philips Tech. Rev.*, **8**, 57–64 (*Feb.*, 1946).—Two mechanical examples of after-effects are first discussed, viz. (*a*) the after-effect in a loaded beam in which, after the initial bending, there is a slow increase to a new equilibrium position; the explanation is given in terms of thermal diffusion due to differences of temperature set up in the original bending; (*b*) a torsional after-effect observed, for example, in Fe only when small amounts of C and N impurities are present; the explanation in this case is one of slow diffusion of the impurities. The problems of dielectric and magnetic after-effects are considered and are shown to be closely related to these mechanical examples. The ferromagnetic after-effect is accounted for by means of a tension set up in the solid, and a discussion is given of the means by which it may be investigated and separated out from other effects such as eddy currents and hysteresis. W. E. D.

PHYSICAL CHEMISTRY 541

REACTION KINETICS 541.121/.128

541.122.2 = 3 2959

The *p T*, diagrams of the silica-carbon and alumina-carbon systems. BRUNNER, R. *Schweiz. Arch. angew. Wiss. Tech.*, **12**, 189–94 (*June*, 1946) *In German.*

541.126 : 537.566 2960

The electrical conductivity of transient flames in hydrocarbons, and its relation to detonation. VICHNIEVSKY, R. *Trans. Faraday Soc.*, **42**, 322–8 (*March–April*, 1946).

541.127.1 2961

The thermal decomposition of silver permanganate. PROUT, E. G., AND TOMPKINS, F. C. *Trans. Faraday Soc.*, **42**, 468–72 (*June–July*, 1946).

ELECTROCHEMISTRY 541.13

541.133 : 621.315.615.2 2962

Conductometric investigation of electrolytic solutions in hydrocarbons. GEMANT, A. *J. Chem. Phys.*, **14**, 424–34 (*July*, 1946).

541.134 : 537.364 *see Abstr.* 2893, 2894

541.135 : 532.7 2963

The Poisson–Boltzmann equation derived from the transfer of momentum. COOLIDGE, A. S., AND JUDA, W. *J. Amer. Chem. Soc.*, **68**, 608–11 (*April*, 1946).—For solutions of electrolytes, the Poisson–Boltzmann equation is derived by postulating a state of balance between electrostatic forces and thermal pressure due to Brownian motion of the ions. It is assumed that the average force on any ion can be calculated from the average field, and with this assumption the average interionic force on the contents of any specified volume can be derived using a stress tensor. The tensor is different from the one familiar in electrostatics in that its components involve the squares of the average field components. In the case of a unidirectional problem the method leads at once to a first order differential equation for the average potential. W. R. A.

541.135 : 539.155.2 *see Abstr.* 2934

541.135.5 : 541.183.7 2964

Properties of the electrical double layer at a mercury surface. II. The effect of frequency on the capacity and resistance of ideal polarised electrodes. GRAHAME, D. C. *J. Amer. Chem. Soc.*, **68**, 301–10 (*Feb.*, 1946).—Experimental studies on Hg surfaces confirm the theoretical deduction that the effect of frequency on the capacitance and resistance of a clean ideally polarized electrode should be negligible. There is no slow stage in the formation of the electrical double layer even when surface-active ions are present. The complex variation of capacitance and resistance on an octyl alcohol-covered Hg surface can be explained if the alcohol layer is assumed to have a resistance dependent upon potential. If the electrical resistance from every element of the surface to the reference electrode is not the same, considerable errors arise in the measurement of capacitance and resistance. The polarization resistance of the double layer is zero on clean polarized Hg surfaces. W. R. A.

541.135.6 2965

The anodic behaviour of metals. II. Gold. HICKLING, A. *Trans. Faraday Soc.*, **42**, 518–22 (*June–July*, 1946).—Previous investigations [Abstr. 2483 (1945)] have been extended to Au. Two main stages in the polarization have been distinguished, corresponding to the charging of a double layer, and the deposition of oxygen at the electrode; from measurements of potentials and quantities of electricity passed it is

concluded that the latter process corresponds to the formation of a unimolecular layer of auric oxide. The behaviour in acid, neutral and alkaline solutions has been shown to be fundamentally the same.

COLLOIDS . . ADSORPTION 541.18

541.18 : 537.363 2966

The boundary anomalies and the electrophoretic analysis of colloidal mixtures. SVENSSON, H. *Ark. Kemi Min. Geol.*, **17 A** (*No.* 3) *Paper* 14, 15 *pp.* (1943).—While the effect of boundary anomalies is well known in one-component systems, this is not the case with colloidal mixtures of several components, but by making certain assumptions, based upon electrophoretic experiments, it has been possible to derive equations for solutions containing an arbitrary number of ion species. These equations are used to study the effect of the boundary anomalies upon the shape of the electrophoresis diagrams. The results obtained by the theory are tested experimentally by a series of electrophoreses with successively decreasing boundary anomalies. Hog serum was chosen as a suitable colloidal mixture, and the analyses described have interest from the standpoint of serum chemistry. H. H. HO.

541.18 : 537.363 2967

The fractionation of proteins by electrophoresis-convection. NIELSEN, L. E., AND KIRKWOOD, J. G. *J. Amer. Chem. Soc.*, **68**, 181–5 (*Feb.*, 1946).—An apparatus is described in which an electric field is applied to carry the proteins in a horizontal direction whilst the resulting density gradient causes convection currents in a vertical direction. Partial separations in the systems horse haemoglobin/bovine serum albumin and horse haemoglobin/azo-ovalbumin have been accomplished. The influence of various factors on the concentrating of proteins is discussed. W. R. A.

541.182.5 : 539.388.8 : 536.7 2968

Some thermodynamic relations of rigid hygroscopic gels. WARBURTON, F. L. *Proc. Phys. Soc., Lond.*, **58**, 585–97 (*Sept.*, 1946).—In studying the absorption of liquids by rigid gels, certain thermodynamic relations are required in terms of stress components and generalized co-ordinates. These have been derived using the analytical methods of Gibbs as developed by Guggenheim, and the conditions under which they hold are clearly defined. The analysis includes a new derivation of Kirchhoff's relation for the heat of absorption, in which it is shown to be an exact relation between the isopiestic and isothermal heat of absorption and the isopiestic and isosteric variation of equilibrium humidity with temperature, where the pressures concerned are the external pressures on the gel-liquid phase. The effect of internal and external stresses is also considered.

541.182.6 : 535.434 : 535.345 = 398 *see Abstr.* 2839

541.183 2969

The variation of the dipole moment of adsorbed particles with the fraction of the surface covered. MILLER, A. R. *Proc. Camb. Phil. Soc.*, **42**, 292–303 (*Oct.*, 1946).—The earlier treatment of heat of adsorption [Abstr. 352 (1940)] is extended to take account of variation of dipole moment, and has been applied to the case of NH_3. The effect of clustering of the particles and the mutual depolarizing effect is shown to reduce the total amount of variation of heat of adsorption by a considerable amount, and since the contributions of Van der Waals' and electrostatic forces are opposite, the resultant variation is much less than that due to either alone. The electrostatic contribution is shown graphically for a range of conditions.

541.183 : 533.7 *see Abstr.* 2808

541.183 : 536.71 2970

Statistical mechanics of multimolecular adsorption. II. Localized and mobile adsorption and absorption. HILL, T. L. *J. Chem. Phys.*, **14**, 441–53 (*July*, 1946).—It is shown that the transition from localized to mobile adsorption (in the first adsorbed layer) takes place at rather low temperatures for potential barriers of around 1 000 cal/mole or less, so that localized physical adsorption should be a very rare phenomenon at the temperatures usually employed in adsorption experiments. Since the Brunauer-Emmett-Teller (and Langmuir) isotherm actually assumes localized adsorption, a new approximate isotherm equation is derived here on the basis of a mobile first layer obeying a 2-dimensional van der Waals' equation. This isotherm is in semi-quantitative agreement with the 2-dimensional phase changes recently observed at very low pressures [Abstr. 1143, 2177 (1946)]. The localized-mobile transition in the absorption of H by metals is mentioned briefly. The relationships between (1) the 2-dimensional equation of state of a monolayer, (2) the adsorption isotherm of the monolayer, and (3) the ordinary 3-dimensional equation of state of the gas being adsorbed are discussed in some detail.

541.183.1 2971

Modifications of the Brunauer, Emmett and Teller equation. ANDERSON, R. B. *J. Amer. Chem. Soc.*, **68**, 686–91 (*April*, 1946).—In the relative pressure range 0·05–0·70, the B.E.T. equation can be applied to many physical adsorption isotherms provided that the relative pressure is multiplied by a constant less than unity. A similar equation, involving an additional constant denoting the upper limit of the layers in which the heat, free energy, or entropy of adsorption are different from the same functions for the liquid, has been fitted to isotherms in the range of relative pressures 0·05–0·98. For porous solids, equations have been presented for adsorption on solids in which the area available to each succeeding layer is less than the previous one. A new type equation has been developed for adsorption limited to n-layers which has better properties than the n-equation of Brunauer, Emmett and Teller. W. R. A.

541.183.3 : 536.7 2972

Thermodynamics of monolayers on solutions. I. The theoretical significance of Traube's rule. WARD, A. F. H. *Trans. Faraday Soc.*, **42**, 399–407 (*May*, 1946).—Changes in free energy have been calculated for adsorption of fatty acid molecules from bulk to surface of water. The logarithm of the initial slope of the γ-c curve ($\log \alpha$) varies linearly with the free energy change. It is shown that the molecules do not lie stretched out on the surface but are in the form of the "most probable" spheroids. The molecular volumes and surface areas of the lower hydrocarbons,

corresponding to the soluble fatty acids, do not vary with chain-length in the same regular way as for the higher hydrocarbons. If they did, $\log \alpha$ would vary almost linearly with $n^{2/3}$ and not with n. The fortuitous manner in which the molecular volumes and areas of the lower hydrocarbons vary with the chain-length is shown to account for the experimentally observed Traube's rule (i.e. $\log \alpha$ depends linearly on n).

541.183.3 : 536.7 2973

Thermodynamics of monolayers on solutions. II. Determination of activities in the surface layers. WARD, A. F. H., AND TORDAI, L. *Trans. Faraday Soc.*, **42**, 408–13 (*May*, 1946).—An expression for the chemical potential in a monolayer is derived by means of the 2-dimensional equation of state. From this it is possible to obtain 2-dimensional analogues of fugacity and activity for the monolayer. Calculations are made for monolayers of myristic acid, butyric acid and phenol at an air-water boundary and for myristic acid at a hexane-water boundary.

541.183.3 : 536.7 2974

Thermodynamics of monolayers on solutions. III. Relationship between surface and bulk activities. Energetics of adsorption. WARD, A. F. H., AND TORDAI, L. *Trans. Faraday Soc.*, **42**, 413–17 (*May*, 1946).—It is shown that the values of the activity of a solute in the surface and in the bulk are proportional to each other. Methods are developed to obtain the proportionality constant between these so that bulk activities may be calculated. Traube's rule is derived thermodynamically, together with an expression by which Traube's constant may be obtained from activity values at moderate concentrations. Free energy changes are calculated for the transference of the solute from bulk to surface.

541.183.33 : 532.72 : 532.612.4 *see Abstr.* 2791

541.183.53 2975

Nitrogen and stearic acid adsorption by supported and unsupported catalysts. RIES, H. E., JR., JOHNSON, M. F. L., AND MELIK, J. S. *J. Chem. Phys.*, **14**, 465–6 (*July*, 1946).

541.183.55 2976

Aggregational states in adsorbed films on incompletely wettable solid surfaces. BANGHAM, D. H. *J. Chem. Phys.*, **14**, 352–3 (*May*, 1946).

541.183.55 2977

Surfaces of solids. XVI. Adsorbed films of water and normal heptane on the surface of graphite. HARKINS, W. D., JURA, G., AND LOESER, E. H. *J. Amer. Chem. Soc.*, **68**, 554–7 (*April*, 1946).—The adsorption isotherms of water and *n*-heptane have been determined on two samples of graphite containing 0·46 and 0·004 wt% of ash. The latter sample was treated to remove from the surface any oxygen-carbon "complex." Above 0·9 relative pressure the films were thicker than monolayers and attained an average thickness of three layers when the relative pressure was 0·98. For low values of P/P_0 the adsorption curves were convex to the pressure axis but flattened out when only a small fraction of a tightly packed monolayer was adsorbed. With hydrophilic solids this occurs when gas sufficient to form a complete monomolecular film has been adsorbed. The spreading coefficient, free energy of emersion, and work of adhesion are −47, 25, and 97 ergs cm^{-2} for water, whilst for *n*-heptane they are 69, 89, and 109 ergs cm^{-2}. Clean graphite gave X-ray diffraction patterns identical with those for solid saturated with water and heptane. The cell constants are $a_0 = 2{\cdot}45_5$ and $c_0 = 6{\cdot}70$ Å. W. R. A.

541.183.55 : 536.42 2978

Surfaces of solids. XVII. A first- and a second-order phase change in the adsorbed film of *n*-heptane on graphite. JURA, G., HARKINS, W. D., AND LOESER, E. H. *J. Chem. Phys.*, **14**, 344–7 (*May*, 1946).—The films of *n*-heptane formed by adsorption on the surface of graphite between 25° and 40°C exhibit a 1st-order phase transition, between the gaseous and liquid expanded phases, and a 2nd-order transition between the liquid expanded and liquid intermediate phases, and between the gaseous and liquid intermediate phases above the critical temperature. The critical constants for the gaseous film were: temperature, 31°C; area, 400 Å^2 per molecule; and film pressure, 1·05 dyne cm^{-1}. These values are different from those found for *n*-heptane on Fe_2O_3, which shows that the solid as well as the gas plays an important role in the determination of the adsorption isotherm. The heat of transition for the 1st-order change is estimated as 13 000 ± 5 000 cal/mole at 25°C. It is found that the heat evolved in the 1st-order transition is the same within this large experimental error on graphite and ferric oxide at corresponding temperatures.

541.183.55 : 536.42 2979

The recognition of phase transitions in adsorbed films on solids. BANGHAM, D. H. *J. Chem. Phys.*, **14**, 352 (*May*, 1946).

541.183.7 : 541.135.5 *see Abstr.* 2964

CHEMICAL STRUCTURE 541.2/.6

541.24 : 535.435 *see Abstr.* 2852

541.57 2980

A relation between bond force constants, bond orders, bond lengths, and the electronegativities of the bonded atoms. GORDY, W. *J. Chem. Phys.*, **14**, 305–20 (*May*, 1946).—A relation of the form $k = aN(x_A x_B/d^2)^{\frac{3}{4}} + b$ has been found to hold accurately for a large number of diatomic and simple polyatomic molecules in their ground states. Here k is the bond-stretching force constant in dynes/cm × 10^{-5}, d the bond length in Å, N the bond order, and x_A and x_B are the electronegativities of the bonded atoms. a and b have the values 1·67 and 0·30, respectively, for stable molecules exhibiting their normal covalencies, except those in which both bonded atoms have only one electron in the valence shell; for diatomic molecules of the alkali metals, Na_2, NaK, etc., a and b are 1·180 and −0·013, respectively; for hydrides of elements having a single electron in the valence shell, 1·180 and 0·040, respectively; and for diatomic hydrides of elements having 2–4 electrons in the valence shell, 1·42 and 0·08, respectively. Numerous applications of the relation are made and certain exceptions are pointed out.

541.57 2981

Force constant of the association bond in the formic and acetic acid dimers. HALFORD, J. O. *J. Chem. Phys.*, **14**, 395–400 (*June*, 1946).—The entropies of the dimers are used to find a minimum value for the force constant. With the aid of a normal coordinate treatment the probable value is found to be 1×10^4 dynes/cm. This agrees with a rough estimate from the heat of dimerization. A Raman band in the formic acid spectrum at 200 cm^{-1} may be due to the association vibrations.

541.57 : 537.226.2 2982

The dipole moment of hydrogen fluoride and the ionic character of bonds. HANNAY, N. B., AND SMYTH, C. P. *J. Amer. Chem. Soc.*, **68**, 171–3 (*Feb.*, 1946).—Using a capacitor of non-reactive material (not described) the permittivity of HF vapour has been measured from 305° to 374°K over a range of pressures. The mean value of the dipole moment is 1·91 D, indicating that the H–F bond is 43% ionic in character. A table is given for the estimation of the approximate amount of ionic character in a bond from the difference in the electronegativities of the two bonded atoms.

W. R. A.

541.57 : 539.13 2983

Theory of the non-tetrahedral carbon atom. DUFFEY, G. H. *J. Chem. Phys.*, **14**, 342–3 (*May*, 1946).—The hybridization of *s* and *p* orbitals to give non-tetrahedral orbitals is discussed. The results are applied to cyclic hydrocarbons. The theory yields an H–C–H angle of 111° 1′ for cyclopentane and 180° for cyclobutane.

541.57 : 539.13 2984

Bond hybridization in the non-tetrahedral carbon atom. KILPATRICK, J. E., AND SPITZER, R. *J. Chem. Phys.*, **7**, 463–4 (*July*, 1946).—Duffey's calculations [Abstr. 2983 (1946)] are criticized, and a different treatment giving a more reasonable result for cyclobutane is outlined.

541.57 : 539.13 2985

The tetrahedral P_4 molecule. ARNOLD, J. R. *J. Chem. Phys.*, **14**, 351 (*May*, 1946).

541.61 : 535.343–15 = 4 *see Abstr.* 2837

541.64 : 535.551 : 532.133 *see Abstr.* 2785

541.65 : 535.32 2986

Group and bond refractions in organosilicon liquids. SAUER, R. O. *J. Amer. Chem. Soc.*, **68**, 954–62 (*June*, 1946).—Analysis of refraction data on a number of organosilicon liquids has led to the assignment of values for the refractions of the following groups: Si–Me, Si–O, Si–Ph, Si–H, Si–Cl. Established refractometric constants have been used to compute the refractions of a large number of reported organosilicon liquids, and a method has been developed by which the average composition of polymethylpolysiloxane systems may be determined from a knowledge of only the refractive index and density.

W. R. A.

541.651 2987

Colour and constitution. VIII. Some colour problems from the viewpoint of resonance theory. HODGSON, H. H. *J. Soc. Dy. Col., Bradford*, **62**, 237–40 (*Aug.*, 1946).—H. E. Armstrong's quinonoid and triple colour-centre hypotheses are discussed from the standpoint of modern resonance theory, on which the quinonoid system is only one type of oscillating system which can exhibit resonance. The older theory fails completely to explain the colours of the aliphatic nitroso-compounds and of the absence of colour in *pp′*-quinonediimine, as well as the enhanced colour of quinhydrone. The earlier attempts, however, laid the foundation for the later quasi-quantitative theory.

CHEMICAL PROCESSES . APPARATUS 542

542.3 : 539.163.4 2988

Ultra-micro methods in nuclear chemistry. SEABORG, G. T. *Chem. Engng News*, 1192 (*May* 10, 1946). *See also Nature, Lond.*, **158**, 313 (*Aug.* 31, 1946).—An account is given of the methods adopted for the direct chemical investigation of the transuranic elements (i.e. the pure compounds, without carriers). Containers, burettes and pipettes made from capillary tubing were used, observed under the microscope, and solution volumes of 10^{-1} to 10^{-5} cm^3 were handled. A new quartz fibre torsion balance weighing 1 μgm to 2% was developed.

542.48 2989

A simple laboratory falling-film molecular still. FARMER, E. H., AND SUTTON, D. A. *J. Soc. Chem. Ind., Lond.*, **65**, 164–6 (*April*, 1946).—The still is of non-cyclic type, gives a vacuum of 10^{-5}–10^{-6} mm (as measured by an ionization gauge) in the distillation vessel, and is suitable for laboratory research work in which moderate quantities of material are to be dealt with. It has a wide range of usefulness for the fractionation of mixtures of liquid of different *M*, and in straight high-vacuum distillation, but is unsuitable for use with viscous liquids which do not flow, or for mobile liquids which do not spread uniformly over the glass distilling surface, at the desired distillation temperature. Details regarding construction, accessories and lay-out are given.

542.923 : 548.735 2990

An X-ray diffraction investigation of the thermal decomposition of silver oxalate. GRIFFITH, R. L. *J. Chem. Phys.*, **14**, 408–15 (*July*, 1946).—A single crystal was studied by X-ray diffraction during the process of thermal decomposition. The diffraction patterns indicated that some fragmentation of the single crystal occurred early in the reaction. Except for distortion, the monoclinic structure was maintained until all trace of Ag oxalate disappeared. The gradual appearance of polycrystalline Ag was apparent. The diffraction patterns showed that a portion of the Ag assumed preferred orientations, the ratio of oriented to unoriented Ag remaining constant throughout the reaction. Four different preferred orientations were found and were defined relative to the Ag oxalate lattice.

542.943 2991

A general discussion on oxidation. *Trans. Faraday Soc.*, **42**, 99–395 (*March–April*, 1946).—Thirty-three papers are collected, with the discussion on each.

542.943 2992

Kinetic studies in the chemistry of rubber and related materials. I. The thermal oxidation of ethyl linoleate. BOLLAND, J. L. *Proc. Roy. Soc. A*, **186**, 218–36 (*July* 9, 1946).

CHEMICAL ANALYSIS 543/545

544.8 : 537.226.31 = 3 *see Abstr.* 2885

545.32 : 669.35.5 2993

Electrolytic detection of small amounts of lead in brass or zinc. McLEAN, D. *Nature, Lond.*, **158**, 307 (*Aug.* 31, 1946).—The Pb particles can be detected by their unique "ringed" appearance under the microscope after electrolytic polishing of the specimen. The necessary polishing conditions depend on the constitution of the specimen. An explanation is given, depending on the local cell action of the Pb particles.

545.82 : 535.33 *see Abstr.* 2830

545.844 = 4 2994

Separation of radioactive ytterbium earths in an adsorption column (radiometric adsorption analysis). LINDNER, R., AND PETER, O. *Z. Naturforsch.*, **1**, 67–9 (*Feb.*, 1946) *In German.*—Radiometric adsorption analysis (chromatographic adsorption with an Al_2O_3 column, using radioactive atomic species) has been applied to the separation of the ytterbium earth elements, i.e. elements 65 to 71, and of yttrium. The separation of dysprosium from holmium, a very difficult process, chemically, is carried out comparatively easily by this method. A. J. M.

545.844 : 532.694.1 2995

Fractionation by adsorption and crystallization on foam. I. Method and principles. SCHÜTZ, F. *Trans. Faraday Soc.*, **42**, 437–43 (*May*, 1946).—A technique is described by which several foam fractions can be obtained from a solution. Substances may be purified either by adsorption on foam, and perhaps crystallization when the foam breaks, or by the removal of surface active substances by foam adsorption. A sudden change of foam stability indicates the removal of one component. The stability of foam from solutions of different concentrations (foam time/concentration curves) may be maximal at certain points. Theory points to the choice of the peak at the lowest concentration for use in the technique. The choice of optimal *p*H, temperature, speed of foaming, and of other factors are discussed. A procedure is described by which some substances, which normally are non-foaming, can successfully be fractionated by the technique.

CRYSTALLOGRAPHY 548

548.0 : 536.631 = 3 *see Abstr.* 2869

548.572 : 535.417 *see Abstr.* 2850

548.713 2996

The number of configurations of molecules on a lattice. MILLER, A. R. *Proc. Camb. Phil. Soc.*, **42**, 303–10 (*Oct.*, 1946).—The number of configurations of mixtures of dimer and single molecules, of trimer and single molecules, and of trimer and dimer molecules is examined by using the Bethe technique when there may be some vacant sites. This condition provides a check on the internal consistency of the Bethe method through the integrability of the resulting partial differential equations.

548.73 2997

War-time progress in X-ray crystal analysis. DOUGLAS, A. M. B., PEISEN, H. S., AND ROGERS, B. W. *Nature, Lond.*, **158**, 260–3 (*Aug.* 24, 1946).—A report of the conference held in London, July, 1946. Outlines of work done 1940–45 in Belgium, Czechoslovakia, Finland, France, Germany and Austria, Great Britain, Holland, India, Norway, Sweden, and U.S.A. are given.

548.73 : 535.37 = 3 2998

X-ray investigation of the structure of zinc sulphide-copper phosphors by the powder method. WECKER, F. *Ann. Phys., Lpz.*, **42** (*Nos.* 7–8) 561–72 (1943).—Qualitative and quantitative investigations of Zn–S–Cu phosphors by means of Debye–Scherrer diagrams. All the ZnS phosphors examined show a pure α-ZnS structure. The changes in luminescence and α-ZnS content by pressure destruction follow along parallel lines. Phosphors destroyed by light and α-rays show no change in modification. In the case of ZnS, destruction by pressure involves increases in density. H. G. S.

548.73 : 536.7 : 531.19 *see Abstr.* 2773

548.73 : 621.385.13.032.216 : 537.583 2999

A study of oxide cathodes by X-ray diffraction methods. II. Oxide coating composition. EISENSTEIN, A. *J. Appl. Phys.*, **17**, 654–63 (*Aug.*, 1946).—[See Abstr. 2404 (1946)]. X-ray diffraction methods were used to investigate time changes in the composition, initially equal molar (BaSr)O. Changes in the bulk of the coating were detected by means of lattice constant measurements. A new method of analysis was developed to determine the variation of composition with depth below the surface. The bulk loss of BaO is primarily a function of the base metal used and the surface loss from the oxide is effected to a lesser extent. Possible correlations with thermionic emission are discussed.

548.733 = 4 3000

Precision measurements of lattice parameters by means of X-rays. NGUYEN, T. C. *Ann. Radioélectricité*, **1**, 236–41 (*Jan.*, 1946) *In French.*—The powder, back-reflection, and symmetrical-focusing methods are explained. A novel form of focusing camera is described, in which spottiness of the lines can be avoided by oscillating large-grained specimens on the circumference of the camera during the exposure. A. J. C. W.

548.733 3001

A vacuum tank for use with a single crystal X-ray goniometer. PERUTZ, M. F., AND ROGERS, G. L. *J. Sci. Instrum.*, **23**, 217 (*Sept.*, 1946).

548.734.382 3002

Intensity measurements with focussing cameras of the Seemann–Bohlin type. HÄGG, G., AND REGNSTRÖM, G. *Ark. Kemi Min. Geol.*, **18 A** (*No.* 1) *Paper* 5, 9 *pp.* (1944).—These cameras are now being used in connection with the photographic determination of the intensities of X-ray powder reflections. The intensity factors are here deduced and the formulae

obtained are tested experimentally. Absolute intensity measurements are also discussed. A. H.

548.735 = 3 3003

Investigations of lattice defects by means of X-rays. II. General theory. VAN REIJEN, L. L. *Physica, 's Grav.*, **11**, 114–28 (*Feb.*, 1944) *In German.*—The intensity of reflection from crystals not perfectly periodic is not concentrated at the points of the reciprocal lattice, but extends throughout reciprocal space. Three important disturbances of periodicity are thermal motion, lattice distortion, and incomplete order. If the distortion is not too great, the distribution of amplitude of reflection in reciprocal space in the second case consists of the usual sharp maximum and a diffuse background which is the Fourier transform of the scalar product of the position vector in reciprocal space and the displacement vector. To a second approximation both parts are reduced by a factor $\exp(-M)$, where M depends on the mean square displacements of the atoms and increases with increasing distance from the origin in reciprocal space. Distortion consisting of a number of independent centres of deformation is treated in some detail. A. J. C. W.

548.735 3004

Investigations of lattice defects by means of X-rays. III. Silver chloride. BURGERS, W. G., AND HIOK, T. K. *Physica, 's Grav.*, **11**, 353–68 (*Feb.*, 1946).—Laue-photographs of AgCl crystals, obtained by recrystallization of material solidified from the molten state, show diffuse bands and spots of similar character as those observed recently with Sn crystals [Abstr. 1970 (1946)], which suggest that definite lattice deviations parallel to the cubic axes and planes are present. After irradiation with a Hg arc the crystals turn violet and show a reflexion parallel to the cubic planes, similar to the effect observed after etching the crystals with a dilute solution of Na thiosulphate. This seems to indicate that the photolytically formed Ag is in some way deposited at, and "parallel" to, the lattice deviations.

548.735 : 542.923 *see Abstr.* 2990

548.735.44 3005

A differential Fourier method for refining atomic parameters in crystal structure analysis. BOOTH, A. D. *Trans. Faraday Soc.*, **42**, 444–8 (*May*, 1946).

548.735.7 : 539.215 3006

Particle size determination from X-ray line broadening. BIRKS, L. S., AND FRIEDMAN, H. *J. Appl. Phys.*, **17**, 687–92 (*Aug.*, 1946).—The X-ray line broadening method of determining particle size was compared with direct measurement on electron micrographs. By controlled heating of the carbonate, MgO particles were prepared from 50 to 1 000 Å in diameter. Calculated particle size agreed to ±10% with the microscope measurements. Mechanical mixtures of two different sizes were examined, but could not be determined unless the two maxima of the distribution curve were completely resolved.

548.736 : 539.388.23 3007

The textures of straight-rolled and of cross-rolled molybdenum. CUSTERS, J. H. F., AND RIEMERSMA, J. C. *Physica, 's Grav.*, **12**, 195–208 (*July*, 1946).—The textures were determined with the aid of X-ray pole figures, which show them to be at least twofold. For example, after cross-rolling, there was found besides the so-called (100) [110] texture ((100) parallel to the rolling plane and [110] parallel to the rolling direction) a second texture, which is rotary symmetrical around the normal to the rolling plane, and which has a (111) plane parallel to this plane. The texture of straight-rolled Mo turns out to be in good agreement with the texture of straight-rolled Fe, as determined by Kurdjumow and Sachs [Abstr. 3874 (1930)]; the texture of cross-rolled Fe is not known.

549.12 : 778.34 : 539.164.93 *see Abstr.* 2939

GEOPHYSICS 55

550.311 = 393 3008

Tensions in the earth's crust as a consequence of pole-shifting. VENING MEINESZ, F. A. *Versl. Ned. Akad. Wet. Afd. Natuurk.*, **52** (*No.* 5) 185–96 (1943) *In Dutch.*—The stresses brought about by a change in position of the rigid earth's crust with regard to the axis of rotation of the earth are investigated; the crust is assumed to have uniform thickness and to behave as an elastic body. Equations are given for the conditions of equilibrium and the relations between stresses and strain, neglecting the bending stresses in the crust. If the vertical component s_ρ of the crustal displacement is supposed to be known over the whole surface, the stresses and the other components of the displacements may be derived from these equations. Using the theories of Huber–Hencky and Bylaard for the origin of plastic deformation in elastic media, the writer has determined the resulting curves of shear over the earth's surface. It is suggested that the earth's crust at some moment of its history has shifted with regard to the poles and that the crust has undergone a corresponding block-shearing.

550.311 : 550.38 = 393 3009

Tensions in the earth's crust resulting from pole shift and the terrestrial magnetic field. VISSER, S. W. *Versl. Ned. Akad. Wet. Afd. Natuurk.*, **52** (*No.* 8) 497–502 (1943) *In Dutch.*—The net of shears derived by Vening Meinesz [Abstr. 3008 (1946)] from the stresses caused by a movement of the axis of rotation shows remarkable correlations with the earth's magnetic field. The net of shears and the primary magnetic field have an equal and equally directed skewness. The net of shears and the secondary magnetic field may be divided into four sectors.

550.37 : 537.224 = 3 *see Abstr.* 2877

550.38 : 550.311 = 393 *see Abstr.* 3009

METEOROLOGY 551.5

551.513.1 : 551.524.7 3010

Thunderstorms and the freezing level. BEERS, N. R. *Bull. Amer. Met. Soc.*, **27**, 54–8 (*Feb.*, 1946).—It is shown from thermodynamical considerations that

phase changes from water to ice or snow will produce large accelerations in ascending air, provided the phase change occurs within a level of accumulation that is not too thick, i.e. if the phase change actually raises the temperature of the ascending air above that of its environment. This is believed to clarify the problem of thunderstorm forecasting by placing emphasis on the importance of the freezing level. The problem of thunderstorms and the freezing level is not yet completely solved and the further information required is outlined. R. S. R.

551.515.23 3011

The recurvature of tropical storms. RIEHL, H., AND SHAFER, R. J. *J. Met.*, **1**, 42–54 (*Sept.*, 1944).—The relations between major alterations of the paths of tropical storms and the upper wind field, especially changes in the height of the base of the polar westerlies, are examined in detail for about 60 cases during 1935–43. If the base lowers greatly west of a storm in connection with an eastward moving middle latitude trough and remains low, northward recurvature will take place. If the upper westerlies cannot maintain themselves in low latitudes, however, the storm will by-pass the northern trough and continue to trend westward. Similar rules are stated for several types of abnormal hurricane tracks, and some observations are made on the formation of tropical storms. R. S. R.

551.524.3 = 5 3012

The mean monthly and annual temperatures at Turin. LOVERA, G. *Atti Accad. Torino*, **78** (*Tomo I*) 77–90 (1942–1943) *In Italian.*—A statistical analysis over a period of 174 years, showing the interdependence of the mean monthly, seasonal and annual temperatures with pressure, rainfall and sunspots.

551.524.7 3013

Distribution of wet bulb potential temperature in latitude and altitude. NORMAND, C. W. B., AND RAO, K. N. *Nature, Lond.*, **158**, 128 (*July* 27, 1946).—A diagram has been prepared by smoothing the available data up to 1941 and its characteristics, particularly with respect to the potential temperature diagram, and the height of the stratosphere, are discussed.

551.524.7 : 551.513.1 *see Abstr.* 3010

551.55 : 551.58 3014

Intertropical convergence zone in the Eastern Pacific region. I. ALPERT, L. *Bull. Amer. Met. Soc.*, **26**, 426–32 (*Dec.*, 1945).—The analysis is based on wind observations made by aircraft using double-drift methods in the area 90° W–95° W and 7° S–14° N (1942–4). The position of the I.C.Z. is found to be furthest south in February–March (1° N–3° N). It moves northward rapidly to a maximum north position in June–October (7° N–10° N). The I.C.Z. is only exceptionally south of the equator. Cyclonic circulations were detected and it is suggested that some of the hurricanes of the Eastern North Pacific develop from them. It is not yet determined whether, during a month when the I.C.Z. is moving rapidly north, it moves as a whole or forms, moves, dissipates and reforms in a new position. G. C. McV.

551.574.7 3015

Certain aspects of aircraft icing in the Alaskan-Aleutian area. SERBEIN, O. N. *Bull. Amer. Met. Soc.*, **26**, 419–25 (*Dec.*, 1945).—1 413 icing cases and 14 843 pilots' reports for the area were examined. During both summer and winter, icing is least at about −11°C, when it is possible. The icing incidence curve displays maxima in the winter at about −36°C and 0°C and in summer at −6°C. Severe ice did not occur in winter above −2°C and in summer only severe-mixed ice occurred above 0°C. Turbulence is associated with all types and intensities of ice and there was no strong correlation between icing intensity and turbulence intensity. G. C. McV.

551.575.1 = 4 3016

Electrical determination of the water content of a fog. PAUTHENIER, M., BRUN, E., AND DEMON. *Bull. Soc. Franç. Élect.*, **3**, 95–6 (*March*, 1943) *In French.*—[See Abstr. 1412 (1946)]. The foggy air is drawn through a light metal cylinder (earthed) in which a wire is suspended axially on insulating supports, being charged to a high negative potential. The fog particles are thus precipitated on the cylinder walls, and the increase in weight of the cylinder gives the water content. Suitable dimensions of the apparatus are given. J. A. W.

551.577.33 : 523.746 = 393 3017

Solar activity and frequency of rain. TETRODE, P. *Versl. Ned. Akad. Wet. Afd. Natuurk.*, **52** (*No.* 10) 684–8 (1943) *In Dutch.*—Taking for each quarter of the years 1868–1939 (De Bilt, Utrecht) the number of days with more than 0·1 mm precipitation in each of the 4×72 pentades, the numbers show marked peaks, with adjoining minima, nearly coincident with the nodes of the ecliptic and solar equator. A similar effect is found for New York (1869–1938) and Melbourne (1907–39). The facts that sunspot numbers increase with latitude and that, possibly, only radial radiation reaches the earth, that the magnetic polarity of sunspots reverses on crossing the equator and that the Coriolis force has a maximum at the equator, indicate that the observed data have a solar origin. J. A. W.

551.577.33 : 551.590.21 3018

The 22 years solar pattern of rainfall in Oklahoma and Kansas. BOLLINGER, C. J. *Bull. Amer. Met. Soc.*, **26**, 376–83 (*Nov.*, 1945).—This paper presents evidence of a dependence of rainfall on the varying output of solar energy from 1886–1943 and of a synchronization of alternating series of wet and dry years with solar cycle indices from relative sunspot numbers. A correlation coefficient of 0·82 with a standard error of $\frac{1}{10}$ of this value is derived from all the material. E. G. M.

551.58 : 551.55 *see Abstr.* 3014

551.590.21 : 551.577.33 *see Abstr.* 3018

551.591.32 3019

Fog and smoke restrictions in the St. Louis area. BECK, N. C. *Bull. Amer. Met. Soc.*, **26**, 315–16 (*Oct.*, 1945).—Observations were made at Parks Airfield 1936–8. The industrial areas of St. Louis lie in the quadrant N.W. to N.E. of the airfield. There is a fog maximum in January and a lesser maximum in June, the latter being due to cold fronts. Air mass analysis of the fog situations is sketched. G. C. McV.

551.593.55 = 393 3020

The measurement of twilight. REESINCK, J. J. M. *Physica, 's Grav.*, **11**, 61–77 (*Feb.*, 1944) *In Dutch.*—The brightness and spectral brightness of the zenith sky during twilight in Holland, under various atmospheric conditions, for solar altitudes between +2° and −6°, were measured with a Se rectifier cell and colour filters. The results for a clear sky are tabulated. For days with a clear sky or with cirrus clouds only, there is a correlation between brightness and colour, the relative amount of blue radiation being the largest on days with the smallest brightness. A theory of the brightness of the zenith is developed under certain simplifying assumptions and compared with observations.

BIOLOGY 57/59

577.1 3021

The structure, function and synthesis of polysaccharides. HAWORTH, W. N. *Proc. Roy. Soc. A*, **186**, 1–19 (*June* 4, 1946).—In this, the Bakerian lecture to the Royal Society, the wide significance of polysaccharides in biochemistry is demonstrated. Some of the substances discussed are cellulose, starch, glycogen and amino-sugars. L. S. G.

578.087.77/.78 : 621.395.614 3022

A piezo-electric unit for general physiological recording. MALCOLM, L. *J. Sci. Instrum.*, **23**, 146–8 (*July*, 1946).—[Abstr. 2131 B (1946)].

578.088.5 : 537.531.9 3023

Effect of X-rays on the rate of turnover of phosphatides. HEVESY, G. *Nature, Lond.*, **158**, 268 (*Aug.* 24, 1946).

578.088.5 : 537.531.9 3024

Effect of Röntgen irradiation on the serum content of haemagglutinins in human blood. BOROWSKAJA, D. *Nature, Lond.*, **158**, 269 (*Aug.* 24, 1946).

591.112 : 539.313 3025

Pressure-volume relation for cylindrical tubes with elastomeric walls: the human aorta. KING, A. L. *J. Appl. Phys.*, **17**, 501–5 (*June*, 1946).—The general theory of the elasticity of elastomers as developed by James and Guth [Abstr. 257 (1944)] is extended and applied to cylindrical elastomeric tubes. Data on human aortas of several age groups are described rather well by the resulting equations. On the basis of this analysis an interpretation of the ageing process for aortas is given. [See also Abstr. 2055 (1945)].

MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

612 : 614 3026

Human ecology in relation to the physico-chemical factors. MATTHEWS, B. H. C. *Nature, Lond.*, **158**, 255–7 (*Aug.* 24, 1946).—A report of a discussion covering the effects of climate (heat, humidity, air movement), oxygen, nitrogen and carbon dioxide pressure, and mechanical acceleration on human physiology.

612.843.14 3027

Concentration of visual purple in the human eye. DE VRIES, H. *Nature, Lond.*, **158**, 303 (*Aug.* 31, 1946).

612.843.31 3028

Fixation area in the human eye. HARTRIDGE, H. *Nature, Lond.*, **158**, 303 (*Aug.* 31, 1946).

612.843.32 : 535.64 *see Abstr.* 2856

612.843.63 3029

Visual thresholds of steady point sources of light in fields of brightness from dark to daylight. KNOLL, H. A., TOUSEY, R., AND HULBURT, E. O. *J. Opt. Soc. Amer.*, **36**, 480–2 (*Aug.*, 1946).—The threshold illumination i at the eye from a steady source of light of 1′ angular diameter in a field of brightness b was measured for b ranging from zero to about 1 500 c/ft² for five observers using both eyes unaided and with natural pupil. A bend in the i, b curve at about $b = 1\,000$ mμL occurred at the transition from foveal to extra-foveal vision. The relation $i = 10^{-10}(1 + b)^{\frac{1}{2}}$, where i is in footcandles and b is in mμL, expressed the experimental data within a factor of 3 over the entire range.

614 : 612 *see Abstr.* 2993

614.8-027 : 621.357.7 3030

Health hazards in the electroplating industry. BOURNE, L. B. *J. Electrodepos. Tech. Soc.*, **21**, 121–8 (1946).

615.844 : 621.396.615.17 3031

Electronic stimulators for medical and physiological purposes. WALTER, W. G., AND RITCHIE, A. E. *Electronic Engng*, **17**, 585–8, 608 (*July*, 1945).—[Abstr. 2428 B (1946)].

615.849 3032

A radon "seed" machine. SPICER, B. A. *J. Sci. Instrum.*, **23**, 207–8 (*Sept.*, 1946).

615.849 : 621.386.1.027.8 3033

A 400 kilovolt installation for X-ray therapy. BOLDINGH, W. H., AND OOSTERKAMP, W. J. *Philips Tech. Rev.*, **8**, 105–10 (*April*, 1946).—[Abstr. 2397 B (1946)].

615.849.5 : 621.386.82 : 537.531 *see Abstr.* 2897

669.35.5 : 545.32 *see Abstr.* 2993

678.1 : 621.315.616.1 : 539.217.3 = 3 *see Abstr.* 2951

PHOTOGRAPHY 77

771.351 : 535.345.1–15 : 535.323.15 = 4 *see Abstr.* 2828

771.356 3034

Improvement of photographic color rendering by correction filters. KREVELD, A. VAN. *J. Opt. Soc. Amer.*, **36**, 412–13 (*July*, 1946).—Multiplying factors of some photographic correction filters are calculated by means of the addition law and are found in fair agreement with the practical figures given by the manufacturers. The improvement of colour rendering

by the correction filters is calculated in the same way; it is very considerable. It is shown that each filter can be characterized by three "improvement-factors," indicating the improvement of the green, yellow and red. The improvement-factors are—in contradistinction to the multiplying factors—nearly independent of the colour-sensitivity of the emulsion. It is argued that green correction filters are not generally useful, whereas (hypothetical) pale orange filters should yield the best possible colour rendering.

771.447.9 3035

Photographic use of electrical discharge flashtubes. EDGERTON, H. E. *J. Opt. Soc. Amer.*, **36**, 390–9 (*July*, 1946).—Xenon-filled gaseous discharge tubes flashed from energy stored in electrical capacitors are very useful converters of electrical energy into light, for both visual and photographic purposes. The efficiency for a typical tube is about 40 lumens/W for rated conditions. Measured values of light output and efficiency as functions of energy input are given for the FT-14 flashtube. A method of measuring the integrated light output is described, as well as typical circuits and electrical conditions. The Xe electrical flashtube is particularly useful for colour photography since its spectral distribution is similar to that of daylight and the spectral distribution and efficiency are not appreciably affected by voltage or life. The quantity of light is predictable in terms of energy input from the storage capacitor. The flashtube is proposed as a standard lamp, especially for flash comparison. An approximate relationship useful for calculating the photographic exposure factor or guide factor (distance × aperture) is given in terms of energy in the capacitor, the type of reflector used, and film speed.

771.448.1 : 535.231 *see Abstr.* 2817

771.531.1–834 : 539.16.08 *see Abstr.* 2936

771.535.01 3036

A study of latent-image formation by a double-exposure technique. BURTON, P. C., AND BERG, W. F. *Photogr. J.*, **86 B**, 2–24 (*Jan.–Feb.*, 1946).

778.33 : 537.531.8 = 4 3037

Radiography and micro-radiography by secondary electrons. SAULNIER, A., AND TRILLAT, J. J. *Rev. Sci., Paris*, **83**, 211–14 (*May*, 1946) *In French.*—Reference is made to previous work by the authors on radiography by secondary electrons emitted from the surface of the material under examination, and a description is given of a new method in which the secondary electrons from a lead sheet are utilized. This sheet, of thickness 0·2 mm, is placed between the X-ray source (at 150–200 kV) and the specimen to be examined. The latter, which must be very thin (some hundredths of a mm), is in contact with the lead and also with the photographic paper or film. If fine-grained film is used micro-radiographs are obtained by magnification. Examples of magnification up to 30 are given. J. T.

778.34 : 549.12 : 539.164.93 *see Abstr.* 2939

778.37 3038

The Scophony high-speed camera. *Photogr. J.*, **86 B**, 42–6 (*March–April*, 1946).—The camera takes 49 pictures at a time on standard 35 mm film at the rate of 10 000 sec. The film is supported on a uniformly rotating drum and the image stabilized thereon by reflection from a prism concentric with and rigidly attached to the drum. The optical, mechanical and electrical problems connected with the design are discussed.

778.37(204.1) : 662.21 3039

High-speed photographs of under-water explosions. SENIOR, D. A. *Photogr. J.*, **86 B**, 25–31 (*Jan.–Feb.*, 1946).—Two methods are available, one consisting of illuminating the subject continuously and regulating exposure and the other consisting of exposing the film continuously but regulating the illumination. The paper only deals with the latter method. Illumination and synchronization with the event, experimental observation of the behaviour of the gas bubble, the apparatus, including under-water protective system, photography by reflected light and silhouette photography are discussed and results shown.

778.552 : 535.88 *see Abstr.* 2860